out means to send out the root retrieval demand which added those weighting values to each channel connected to this on the basis of the end of a local when starting a communication link after choosing the root as the method of a course of the channel between predetermined phase hands, and said root retrieval demand When it comes in the form which added said weighting value of the channel via which it went till then, A root retrieval demand junction means to send out to the predetermined channel which referred to the weighting value of each channel connected to this on the basis of the end of a local, and was chosen from from among these channels in the form where the weighting value of the channel was added, When the root retrieval demand which used the end of a local as the communicative phase hand comes A root decision means to determine the optimal root based on said weighting value of the added channel via which it went till then, When the notice by this notice means of a root retrieval result comes to the notice means [to notify the root determined by this root decision means to the sending-out origin of a root retrieval demand] of root retrieval result, and sending-out origin of a root retrieval demand, A communication link initiation means to start a communication link to the phase hand of said communication link according to the root shown in this, A data junction means by which the sending-out origin of said root retrieval demand sends out the data sent out after root decision to the following channel according to this root, The wireless terminal characterized by providing a notice means at the time of communication link [which notifies this to the terminal which started the communication link using the remainder of the root which said root decision means determined when it became impossible to have used the channel to which this data junction means sends out data] improper.

[Claim 4] claim 1 which the weighting value added to a root retrieval demand is an aggregate value of the weighting value of each channel via which it went from the sending-out origin of a root retrieval demand, and is characterized by said root decision means determining the optimal root based on the magnitude of this aggregate value - claim 3 -- a wireless terminal given in either.

[Claim 5] claim 1 characterized by acting as intermediary by said root retrieval demand junction means choosing the channel which does not use the channel already chosen with reference to the root sent with said root retrieval demand - claim 3 -- a wireless terminal given in either.

[Claim 6] as for said root decision means, said root retrieval demand should pass each root with said weighting value -- claim 1 characterized by determining the optimal root using a duration until it is received - claim 3 -- a wireless terminal given in either.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Especially this invention relates to the wireless terminal which can set up the root between the terminals of the phase hand who communicates by the local network with respect to a wireless terminal.
[0002]
[Description of the Prior Art] Wireless terminals, such as a personal digital assistant, have spread broadly, and attentions have gathered also for the local communication link of these wireless terminals with this. The typical thing of such a local network is an ad hoc (ad hoc) network. An ad hoc network is a local network created temporarily if needed, and the wireless terminal which constitutes a network does not know a mutual existence in advance. Moreover, the server which manages these networks intensively does not exist. Each wireless terminal does not need a special setup for a communication link, but can recognize a surrounding wireless terminal autonomously, can build a network, and can do informational exchange and an informational share. For this reason, it may say that the wireless terminal which existed on the network leaves suddenly, and the structure which can be adapted to such change is searched for.
[0003] In case such a local network is formed, via what kind of wireless terminal data are transmitted to other wireless terminals poses a problem from a certain wireless terminal. In transmitting and receiving data between computers generally, it transmits IP data from the IP address of arbitration to IP (Internet Protocol) address of the destination using a routing protocol by the network layer in OSI (Open System Interconnection: open systems interconnection). In this case, the 1st technique of adopting distance vector routing made into the conditions of selection of distance as a routing protocol for routing to be used and the 2nd technique of adopting link state-vector routing made into the conditions of selection of a link condition exist.
[0004] In distance vector routing as the 1st technique of these, the pop number as the number of counts of the gateway hop as an element which determines the delivery root of IP datagram is used, and the distance vector is computed. And the root is determined because a distance vector chooses a short path. A pop number means the number of the gateways which will meet by the time IP datagram reaches even to the destination terminal connected to other LANs from the starting point connected to a certain LAN (Local Area Network) here.
[0005] He maps the information which shows whether the link between the approaching gateways is usable, and is trying to apply the Dijkstra (Djikstra) algorithm as an algorithm of the network shortest path planning in routing using the link state vector as the 2nd technique. In this case, he is trying to calculate the minimum distance over all ending points from the one starting point.
[0006] On the other hand, the various proposals of the technique or technique about routing are made besides this. For example, whenever it receives the error packet generated when distance vector routing as the 1st technique is applied and the life time of the packet signal for retrieval expires, he is trying to make the number of hop increase by the 3rd technique proposed by

JP,2000-49852,A. That is, by this proposal, the priority of the path to choose is changed by making a distance vector increase.
[0007] Moreover, what was proposed by JP,2000-341199,A as the 4th technique exists. He chooses a communication path using two or more communication-path information that priority was attached beforehand, and is trying to build a network system by this 4th technique. And when an error occurs in one of communication paths, he is trying to return the data which added this error information to a transmitting agency. If error information is received, he is trying not to reduce communication link efficiency to the degree of the path information which he has by changing to the high communication path of priority at a transmitting agency.
[0008] Furthermore, the 5th technique which was proposed by JP,2000-4469,A also exists. This 5th technique is applied to the radio communications system which consists of a center station, two or more junction nodes, and two or more wireless terminals. By this technique, a center station outputs an adjustment demand signal and a wireless terminal receives this through a junction node. A wireless terminal is transmitted by the radio wave by return [quality information /, such as received field strength and a bit error rate,]. In two or more above mentioned junction nodes which received the radio wave of this wireless terminal, the receiving quality information of a radio wave is added to this, and it transmits to a center station.
[0009]
[Problem(s) to be Solved by the Invention] By the way, a network situation tends to change as compared with the channel according [the channel which used wireless] to a cable. For example, field strength not only always changes with time amount, but produces the phenomenon of phasing. Phasing is the fluctuation phenomenon of a carrier frequency in which interfere mutually and the strength changes here, when an electric wave causes reflection, diffraction, and dispersion with a building, a tree, etc. The transceiver error of data may occur from a transmitting agency to a reception place by considering these change of a situation as a cause. Extent of a transceiver error appears as a bit error rate. If a bit error rate is above high to some extent, a communication link will become impossible and the accident in which a communication link is cut will occur. Thus, a communicative transfer rate is important for the communication link quality in radio, and the quality judging by the bit error rate also becomes important.
[0010] For this reason, even if various kinds of proposals which were explained above tended to apply to local networks, such as an ad hoc network, as it is, that application was difficult for them. This is explained below.
[0011] First, the 1st technique is looked at. If it limits when computing vector distance to a static network, a problem will not produce especially this technique. It is because it is comparatively easy to create a path table about all termination. However, the 1st technique is not suitable in being an already explained local network like an ad hoc network. In a local network, it is because it is not realistic to create a path table about all termination in order to redo path retrieval of plurality whenever the wireless terminal which was relaying data interchanges, as already explained and for the path retrieval itself to take time amount moreover.

[0012] Routing using the link state vector as the 2nd technique covers the fault of the routing processing by the distance vector in the 1st technique. That is, the path retrieval by the link state vector judges whether the adjoining gateway and a communication link are possible, by this, creates a root map and calculates the minimum distance to each root. However, if the local network by wireless, such as an ad hoc network without the gateway of dedication, is constituted using this 2nd technique, it will become difficult to search the optimal path. In the network by the radio which changes by time amount with network comparatively short quality, it is because the optimal path cannot be searched only with a link information.
[0013] Whenever it receives an error packet as an application form of a distance vector, he is trying to make the number of hop increase by the 3rd technique on the other hand. Thus, it is effective to lower the priority of the path chosen by making the number of hop increase, and to choose the optimal root in the usual network. However, at the local network of the character in which network quality changes to comparatively short time amount, for example under the mobile environment, the optimal path cannot be chosen only by the technique of making the number of

hop increase and lowering priority with the passage of time.
[0014] Next, the 4th technique is considered. When an error occurs, it is made to correspond to a communication link situation by changing to the communication path of the following priority by this 4th technique. However, it is the information about the priority saved beforehand which is chosen as following priority. Therefore, as described above, in changing by time amount with network comparatively short quality, what was distinguished based on the saved information as it is the following ranking not necessarily shows the optimal path at the time.
[0015] Finally the 5th technique is considered. In case routing is performed using field strength and a bit error and the communication link with a relay center is performed to the terminal of arbitration, it enables it to choose the Communication Bureau with sufficient communication link quality by the 5th technique. However, if it is going to apply this technique when a wireless terminal plays a role of a relay center in coincidence like an ad hoc network, unlike the communication configuration of one-pair plurality of a relay center and a wireless terminal, more than one will become the communication link of opposite plurality. Therefore, the root cannot be searched using this 5th technique.
[0016] Then, the purposes of this invention are local networks, such as an ad hoc network, and are to offer the wireless terminal with which the optimal root required for a communication link can be searched in a short time.
[0017]
[Means for Solving the Problem] A weighting value setting means to set up the weighting value as a reference value of the selection at the time of communicating using these channels for each [which was connected to other terminals which adjoin a (b) end in invention according to claim 1] channel of every, When it comes in the form where the root retrieval demand for setting up the root of the communication link which used the predetermined terminal as the communicative phase hand from the terminal of (b) others added the weighting value of the channel via which it went till then, A root retrieval demand junction means to send out to the predetermined channel which referred to the weighting value of each channel connected to this on the basis of the end of a local, and was chosen from from among these channels in the form where the weighting value of the channel was added, (Ha) When the root retrieval demand which used the end of a local as the communicative phase hand comes a root decision means to determine the optimal root based on the weighting value of the added channel via which it went till then, and (d) -- a wireless terminal is made to possess a notice means of a root retrieval result to notify the root determined by this root decision means to the sending-out origin of a root retrieval demand
[0018] That is, in invention according to claim 1, the weighting value as a reference value of the selection at the time of communicating using these channels for each [by which the wireless terminal was connected to other terminals which adjoin an end] channel of every is set up. and when the root retrieval demand for setting up the root of the communication link which used the predetermined terminal as the communicative phase hand from other terminals comes While choosing some of the channels which refer to a weighting value and are connected in the end of a local, a root retrieval demand is sent out to the channel these-chosen as the weighting value of the old channel added and sent to the root retrieval demand in the form where the weighting value of this channel was added. Thus, when the root retrieval demand is sent, the root retrieval demand of **** will be sent to a communicative phase hand at last. When a root retrieval demand comes, he is trying to determine the optimal root by the communicative phase hand based on the weighting value of the added channel via which it went till then. And he is trying to tell the side which starts a communication link about this root with the notice means of a root retrieval result. Thus, in invention according to claim 1, since the root can be determined when a root retrieval demand is sent to a communicative phase hand, quick retrieval of the root is attained. Moreover, in the side which starts a communication link, retrieval processing of the root becomes easy.
[0019] A bit error rate measurement means to measure the bit error rate of each channel connected to other terminals which adjoin a (b) end in invention according to claim 2, A transfer rate setting means to set up the above mentioned data transfer rate which was connected to

other terminals which adjoin a (b) end and which used those channels for every channel, A weighting value setting means to set up the weighting value as a reference value for setting up the root of the communication link performed between a phase hand's terminals using each channel based on measurement and the contents of a setting of these bit error rate measurement means and the transfer rate setting means, (Ha) A root retrieval demand sending-out means to send out the root retrieval demand which added those weighting values to each channel connected to this on the basis of the end of a local when starting a communication link after choosing the root as the method of a course of the channel between (d) predetermined phase hands, When it comes in the form where the (e) root retrieval demand added the weighting value of the channel via which it went till then, A root retrieval demand junction means to send out to the predetermined channel which referred to the weighting value of each channel connected to this on the basis of the end of a local, and was chosen from from among these channels in the form where the weighting value of the channel was added, (Passing) When the root retrieval demand which used the end of a local as the communicative phase hand comes A root decision means to determine the optimal root based on the weighting value of the added channel via which it went till then, (g) When the notice by this notice means of a root retrieval result comes to the notice means [to notify the root determined by this root decision means to the sending-out origin of a root retrieval demand] of root retrieval result, and sending-out origin of a (h) root retrieval demand, A wireless terminal is made to possess a communication link initiation means to start a communication link to a communicative phase hand according to the root shown in this.

[0020] That is, in invention according to claim 2, the weighting value as a reference value of the selection at the time of communicating using these channels for each [by which the wireless terminal was connected to other terminals which adjoin an end] channel of every is set up. The measurement result of the bit error rate of each channel to which the end of a local and end by the bit error rate measurement means were connected, and the setting result of the data transfer rate to which the end of a local and end by the transfer rate setting means were connected and which used those channels for every channel are used for a setup of a weighting value. A data transfer rate may be decided by the negotiation between the terminals which counter through a channel. In invention according to claim 2, it has the root retrieval demand sending-out means. A root retrieval demand sending-out means is a means to send out the root retrieval demand which added those weighting values to each channel connected to this on the basis of the end of a local, when starting a communication link after a wireless terminal chooses the root as the method of a course of the channel between predetermined phase hands. Although a root retrieval demand is sent to a communicative phase hand via a channel, the terminal which acts as intermediary then adds the weighting value about the channel, when sending out a root retrieval demand to a channel, while referring to these weighting values about selection of the channel on the basis of the end of a local. A communicative phase hand will determine the optimal root based on the weighting value of each old channel, when the root retrieval demand has been sent. The notice means of a root retrieval result will notify the root determined by this root decision means to the sending-out origin of a root retrieval demand. Based on this, a communication link initiation means will start a communication link to a communicative phase hand according to the notified root. Thus, in invention according to claim 2, since the root can be determined when a root retrieval demand is sent to a communicative phase hand, quick retrieval of the root is attained. Moreover, in the side which starts a communication link, retrieval processing of the root becomes easy. Furthermore, since the weighting value is set up using a bit error rate and a data transfer rate, the proper root can be chosen from the both sides of transmission speed and the dependability of data.

[0021] A weighting value setting means to set up the weighting value as a reference value of the selection at the time of communicating using these channels for each [which was connected to other terminals which adjoin a (b) end in invention according to claim 3] channel of every, A root retrieval demand sending-out means to send out the root retrieval demand which added those weighting values to each channel connected to this on the basis of the end of a local when starting a communication link after choosing the root as the method of a course of the channel

between (b) predetermined phase hands, When it comes in the form where the root retrieval demand added the weighting value of the channel via which it went till then, (Ha) A root retrieval demand junction means to send out to the predetermined channel which referred to the weighting value of each channel connected to this on the basis of the end of a local, and was chosen from from among these channels in the form where the weighting value of the channel was added, When the root retrieval demand which used the end of a (d) local as the communicative phase hand comes A root decision means to determine the optimal root based on the weighting value of the added channel via which it went till then, (**), when the notice by this notice means of a root retrieval result comes to the sending-out origin of a root retrieval demand in **, a notice means of a root retrieval result to notify the root determined by this root decision means to the sending-out origin of a root retrieval demand, and A communication link initiation means to start a communication link to a communicative phase hand according to the root shown in this, A data junction means by which the sending-out origin of a (g) root retrieval demand sends out the data sent out after root decision to the following channel according to this root, (h) When it becomes impossible to use the channel to which this data junction means sends out data, a wireless terminal is made to possess a notice means at the time of communication link [which notifies this to the terminal which started the communication link using the remainder of the root which the root decision means determined] improper.

[0022] That is, in invention according to claim 3, the weighting value as a reference value of the selection at the time of communicating using these channels for each [by which the wireless terminal was connected to other terminals which adjoin an end] channel of every is set up. and when the root retrieval demand for setting up the root of the communication link which used the predetermined terminal as the communicative phase hand from other terminals comes While choosing some of the channels which refer to a weighting value and are connected in the end of a local, a root retrieval demand is sent out to the channel these-chosen as the weighting value of the old channel added and sent to the root retrieval demand in the form where the weighting value of this channel was added. Thus, when the root retrieval demand is sent, the root retrieval demand of **** will be sent to a communicative phase hand at last. When a root retrieval demand comes, he is trying to determine the optimal root by the communicative phase hand based on the weighting value of the added channel via which it went till then. And the side which starts a communication link is told about this root with the notice means of a root retrieval result, and communicative initiation is enabled with the communication link initiation means. However, even if a communication link is started, the terminal which has become a part of root moves, and there is a case where it becomes impossible to use the channel to which a data junction means sends out data by the reason of junction becoming impossible etc. Resetting of the root is attained if needed by using the part of the near root where the corresponding terminal does not exist, when such, and notifying this to the terminal with which the notice means started the communication link at the time of communication link improper. Also in this case, the action with them is possible. [there are few burdens of the terminal of the side which resumes a communication link, and prompt]

[0023] invention according to claim 4 -- claim 1 - claim 3 -- the weighting value added to a root retrieval demand at a wireless terminal given in either is an aggregate value of the weighting value of each channel via which it went from the sending-out origin of a root retrieval demand, and the root decision means is characterized by determining the optimal root based on the magnitude of this aggregate value.

[0024] That is, in invention according to claim 4, since the weighting value added to a root retrieval demand is an aggregate value of the weighting value of each channel via which it went from the sending-out origin of a root retrieval demand, it can shorten data lengths, such as a packet sent out rather than the case where each value is added and sent out according to an individual. Moreover, by the communicative phase hand, the optimal root can be easily distinguished from the smallest thing or the largest thing of this aggregate value. In addition, respectively with [the weighting value of each channel] one [or more], integrating instead of addition is also possible.

[0025] invention according to claim 5 -- claim 1 - claim 3 -- the root retrieval demand junction

means is characterized by acting as intermediary by choosing channels other than the channel already chosen with reference to the root sent with the root retrieval demand at the wireless terminal given in either.
[0026] That is, by invention according to claim 5, selection of a path which forms a closed loop in this side which reaches a communicative phase hand is prevented by making it not choose the already chosen channel again, when choosing a channel one after another and setting up the root.
[0027] invention according to claim 6 — claim 1 – claim 3 — as for a root decision means, a root retrieval demand should pass each root with a weighting value at a wireless terminal given in either — it is characterized by determining the optimal root using a duration until it is received.
[0028] That is, by invention according to claim 6, realistic routing is made possible by taking into consideration the time amount which the communication link of a root retrieval demand etc. actually takes.
[0029]
[Embodiment of the Invention]
[0030]
[Example] This invention is explained to a detail per example below.
[0031] Drawing 1 shows the local network applied in the one example of this invention. As shown in this drawing, two or more wireless terminals 111–118 shall exist in the comparatively narrow field. The figures from "1" to "8" described into the circle (O) which shows each wireless terminal 111–118 shall show the terminal address of these terminal propers. The 5th wireless terminal 115 moves from other locations, and this drawing shows the condition of having participated in this local network. The straight line which ties each wireless terminals 111–118 expresses the mutual link 12. When the 5th wireless terminal 115 participates in a network in this example, the link 12 for performing the communication link of other wireless terminals 11 in this network and data will be stretched. On the contrary, if the 8th wireless terminal 118 secedes from a network, that link 12 will be canceled at this time. Therefore, the wireless terminal 11 which was communicating using the canceled link 12 needs to use other links 12.
[0032] Drawing 2 expresses functionally the circuitry of the wireless terminal which participates in this local network. although the circuitry of the 5th wireless terminal 115 was shown here — the 1– the 4th wireless terminal 111–114 and the 6– the functional configuration of the circuit of the 8th wireless terminal 116–118 is also fundamentally the same as that of this.
[0033] The 5th wireless terminal 115 is equipped with the parameter detecting element 21 which detects the various parameters at the time of performing routing between the terminal of data transmitting origin, and the terminal of the arbitration of a data transmission place by the wireless local network as shown in drawing 1 , and the detection result preservation section 22 for saving various detection results. The transfer rate negotiation section 31 to which the parameter detecting element 21 carries out the negotiation of the transfer rate with the terminal which transmits a packet, The bit error rate detecting element 32 which detects the bit error rate for the communication link with this terminal, The link condition detecting element 33 for checking the existence of the link between each adjoining terminal (connection), The routing weighting calculation section 34 which computes weighting for although routing is performed with the detected bit rate and a transfer rate, The root weighting adder unit 35 which carries out sequential addition of the result of weighting in case routing is performed, The root find command sending–out section 36 which sends out the root find command for performing root retrieval in case it communicates, It passes along the retrieval routing section 37 which chooses the searched optimal root, the retrieval root answerback section 38 which performs answerback for returning this optimal root to the terminal which published the find command, and the selected root. It has the routing–data transfer section 39 which transmits routing data for the terminal located in the middle to transmit the data of a transmitting agency to a destination terminal.
[0034] The transfer rate preservation section 41 where the detection result preservation section 22, on the other hand, saves the transfer rate as a result of the negotiation in the transfer rate negotiation section 31 in the parameter detecting element 21, The bit error rate preservation

section 42 which saves the bit error rate which the bit error rate detecting element 32 detected, The link condition preservation section 43 which saves the current link condition which the link condition detecting element 33 detected, the 1- the 4th wireless terminal 111-114 and the 6- with the terminal address preservation section 44 which saves the terminal address original with the 5th wireless terminal 115 which does not lap with the 8th wireless terminal 116-118 as the self address It has the retrieval root preservation section 45 which saves the optimal root as a result of retrieval.

[0035] Drawing 3 shows the outline of the circuitry of the 5th wireless terminal equipped with such a functional configuration. Moreover, drawing 4 and drawing 5 express still more concretely the important section of the circuit of this 5th wireless terminal. the 1- the 4th wireless terminal 111-114 and the 6- since it is fundamentally the same, the circuitry of the 8th wireless terminal 116-118 also abbreviates the explanation about these to these drawings.

[0036] The 5th wireless terminal 115 is equipped with the information processing CPU (central processing unit) unit 51 for performing various control as shown in drawing 3 . The information processing CPU unit 51 is constituted by timer 51C, interrupt controller 51D, and bus controller 51E connected to CPU(central processing unit)51A and this CPU51A by internal bus 51B as shown in drawing 4 . Here, interrupt controller 51D has connected interrupt control-line 51F, and receives interruption to CPU51A. Although timer 51C is the hardware for a time check, it can also instead consist of software using the control program which counts a clock. Bus controller 51E has connected Maine Bath 52 for connecting other circuit apparatus with the information processing CPU unit 51 shown in drawing 3 .

[0037] It returns to drawing 3 and explanation is continued. The information processing CPU unit 51 has connected the 1st oscillator 50 which receives supply of a clock signal. The information processing CPU unit 51 is connected with each part within a terminal through Maine Bath 52. Among these, the memory unit 53 consists of ROM53A and RAM53B, as shown in drawing 5 . ROM53A is the read only memory which stored required fixed data while storing the control program which CPU51A shown in drawing 4 performs. RAM53B is for saving temporary data, such as progress of an operation when various data processing is performed or CPU51A processes retrieval of the root etc. based on this control program, and a processing result, and is constituted by random access memory.

[0038] The I/O (I/O) control unit 54 in drawing 3 has connected the key input section 55, and performs interface conversion with this and Maine Bath. The key input section 55 is a part used as the user interface that a user starts retrieval processing of a terminal.

[0039] The display unit 56 is equipment which displays visual data, such as various processing results. A communications control unit 57 controls the communication link with other wireless terminals, and has connected the RF (Radio Frequency: radio frequency) unit 59 which connected the antenna 58 in this example. The RF unit 59 is a circuit which performs magnification and detection of an analog radio signal, and an antenna 58 transmits and receives an analog radio signal here. The 2nd oscillator 61 is connected to the RF unit 59, and the 3rd oscillator 62 is connected to the communications control unit 57, respectively, and a predetermined dispatch output is supplied. It connects with interrupt control-line 51F shown by drawing 4 , and the information processing CPU unit 51 receives required interrupt control.

[0040] Each circuit in the detection result preservation section 22 of the transfer rate preservation section 41 grade shown by drawing 2 is constituted using each field of RAM53B in the memory unit 53. Moreover, the parameter detecting element 21 is constituted by the information processing CPU unit 51 and the RF unit 59 grade.

[0041] Drawing 6 and drawing 7 express the flow in the phase of the beginning of processing in case one of the wireless terminals of a configuration as explained above participates in a local network. As an example, in order that the 6th wireless terminal 116 may start a communication link between the 1st wireless terminal 111, it may participate in a local network. For example, it is a case so that application which transmits the data about the schedule by which the 6th wireless terminal 116 is stored in self equipment to the 1st wireless terminal 111 may be started. Of course, as shown in drawing 1 , the 6th wireless terminal 116 may approach this local network that consists of the 5th wireless terminal 115 grade, and it may participate in this by a certain

reason.
[0042] In such a case, to the terminal which is located in the perimeter and can relay a packet to other terminals, the 6th wireless terminal 116 will send out a terminal retrieval demand, and will try connection. Even when the 6th wireless terminal 116 tries a communication link between the 1st wireless terminal 111 In order to make a communication link start to the 1st wireless terminal 111 which is not understood through what kind of the root I may communicate at the time Send out the demand which connects with the terminal near a local station first, and is connected with the 1st wireless terminal 111 to these terminals, and when these terminals are not the 1st wireless terminal 111 It is because it is finally necessary to transmit the demand to the 1st wireless terminal 111, making other terminals spread the same demand one after another.

[0043] The 6th wireless terminal 116 sends out a terminal retrieval demand to the perimeter with hand control or automatic first (drawing 6 step S101). The self-address of the 6th wireless terminal 116 as a connection-request terminal is included in the terminal retrieval demand. The retrieval by hand control is the case where retrieval is performed intentionally, in order that the user of the 6th wireless terminal 116 may discover the community which forms the local network and may connect with the community. On the other hand, the retrieval by automatic is the case where the set of timer 51C shown in drawing 4 searches periodically for every fixed time amount to the 6th wireless terminal 116.
[0044] Drawing 8 expresses the condition that the 6th wireless terminal tries the wireless terminal of the perimeter, and connection. In this example, the 5th, 3rd, 7th, and 8th wireless terminals 115, 113, 117, and 118 exist in the range which the wireless of the 6th wireless terminal 116 reaches. Therefore, answerback may come by the example shown in this drawing 8 from these terminals. In order to simplify explanation, the case where there is answerback from the 5th wireless terminal 115 is explained.
[0045] The 5th wireless terminal 115 sends out the self-address of a connected terminal, i.e., the self-address of the 5th wireless terminal 115, as a connection-confirm response to this 6th wireless terminal 116 as a connection-request terminal, if a terminal retrieval demand of the 6th wireless terminal 116 is received (step S102). The 6th wireless terminal 116 is that the self-address of the 5th wireless terminal 115 comes to hand, and it means that the wireless terminal to connect was discovered. Therefore, the link connection demand for establishing a communication link is sent out to this address that came to hand (step S103). The 5th wireless terminal 115 as a connected terminal returns a connection-request Acknowledgement to the 6th wireless terminal 116 to this (step S104).
[0046] Based on this, the 6th wireless terminal 116 sends out the demand of a transfer rate, in order to carry out the negotiation of the full speed of a transfer rate between this 5th wireless terminal 115 next (step S105). At this time, the maximum of a transfer rate which can respond by the 6th wireless terminal 116 side to the 5th wireless terminal 115 is notified. On the other hand, the 5th wireless terminal 115 carries out answerback of a purport which can respond to the maximum of the notified transfer rate (step S106:Y). When it cannot respond to this rate, the maximum transfer rate which can respond by the 5th (N) terminal [wireless] 115 side will be notified (step S107).
[0047] When the 5th wireless terminal 115 has answered that a transfer is possible at the maximum of the transfer rate of the 6th wireless terminal 116 (step S106:Y), the transfer rate negotiation section 31 in the parameter detecting element 21 shown in drawing 2 saves this in the transfer rate preservation section 41 in the detection result preservation section 22 (step S108). On the other hand, when [the 5th wireless terminal 115] it cannot transmit at the transfer rate of the 6th wireless terminal 116, the transfer rate to which self can respond is notified (step S107:Y). Then, the transfer rate preservation section 41 will save this transfer rate in the transfer rate preservation section 41 similarly in this case (step S109).
[0048] Drawing 9 expresses the response corresponding to a demand and this of the transfer rate between two terminals. The 6th wireless terminal 116 sends out the demand of a transfer rate (step S105), and the 5th wireless terminal 115 is performing answerback to this (steps S106 and S107).

[0049] Thus, if the maximum transfer rate to each of a link and each of these links for the 6th wireless terminal 116 to start a communication link is called for, CPU described above in the information processing CPU unit 51 (drawing 3) will perform detection of the bit error to the terminal (for example, 5th wireless terminal 115) which can stretch a link. Specifically, the predetermined data packet as data for a check for the command of bit error detection and detection will be sent out to the 5th wireless terminal 115 of a link place (R> drawing 7 7 step S110).

[0050] Here, an explanation supplement is carried out about the predetermined data packet as data for a check. This data packet is attached to the bit error rate detection command for detecting a bit error rate, is sent out, and consists of packets of the specific number used as the specific bit array (bit pattern) beforehand defined between local networks. Each wireless terminal 11 which constitutes a local network is held as a packet for collating in ROM which described above the pattern used as the radical which derives the same thing or this same as this data packet altogether, and the formula. Therefore, the error incidence rate in the root which faces to the wireless terminal 11 of the 5th following wireless terminal 115 grade from the 6th wireless terminal 116 is detectable by receiving the sent-out data packet and collating this with the packet for collating with a bit error rate detection command.

[0051] By the way, the bit pattern for computing such a bit error rate is detected by the bit error rate detecting element 32 shown in drawing 2 in the 5th wireless terminal 115. The bit error rate detecting element 32 counts the number of a bit which caused the error for the above mentioned bit pattern of each of the packets of the specific number as compared with the bit pattern of the packet for collating. And the incidence rate of an error is computed by dividing the number of this error searched for by the total number of bits of a data packet.

[0052] The bit pattern of the data packet used for calculation of a bit error is devised so that a bit string may not become a specific list unsuitable to detection. For this reason, random bit string generation machines, such as an M sequence data generation machine, are used, for example. If an M sequence data generation machine is used, a common random bit pattern is generable among these because each wireless terminal 11 prepares the bit pattern used as the polynomial which generates a bit pattern, and the kind (or origin) used by the polynomial. Therefore, it is not necessary to have all the bit patterns for bit error calculation every wireless terminal 11.

[0053] This will be returned to the 6th wireless terminal 116 of a sending out agency if the 5th wireless terminal 115 side computes a bit error rate about a data packet in the example shown above. The 6th wireless terminal 116 is standing by reception of this bit error rate (drawing 7 step S111). And if a bit error rate is received, (Y) and this are matched with the terminal (here 5th wireless terminal 115) of a transmission place, and this is saved in the bit error rate preservation section 42 shown in drawing 2 (step S112).

[0054] Drawing 10 expresses sending out of the bit error rate detection command between two terminals, and the situation of the answerback to this. The 6th wireless terminal 116 sends out a bit error rate detection command (step S110), and the 5th wireless terminal 115 is performing answerback to this (step S111).

[0055] To each of the 5th, 3rd, 7th, and 8th wireless terminals 115, 113, 117, and 118 shown in drawing 8 , processing of such detection of a bit error rate is performed, as arrow heads 2515, 2513, 2517, and 2518 show, and each result is saved in the bit error rate preservation section 42. Moreover, the link condition preservation section 43 saves the link condition of the these [to which the link was set at present] 5th, 3rd, 7th, and 8th wireless terminals 115, 113, 117, and 118.

[0056] Drawing 11 expresses the flow of processing of weighting of the link performed between the terminal which participated in the local network as processing after the processing shown in drawing 6 , and the terminal of the perimeter. For example, the 6th wireless terminal 116 shown in drawing 8 sets up weighting for every link as data required for a communication link or a setup of the root in the case of junction about each terminal of the 5th [which stretched the link / of the circumference], 3rd, 7th, and 8th wireless terminals 115, 113, 117, and 118. The bit pattern rate in the link between the these 5th, 3rd, 7th, and 8th wireless terminals 115, 113, 117, and 118

is used for this setup (step S121).
[0057] While the these 5th, 3rd, 7th, and 8th wireless terminals 115, 113, 117, and 118 also set up a link with that about the 6th wireless terminal 116 as a terminal which newly participated, it needs to perform weighting of the root at the time of performing routing. In the case of the latter, the 5th, 3rd, 7th, and 8th wireless terminals 115, 113, 117, and 118 can perform weighting, using directly the bit error rate between the 6th wireless terminal 116 which self computed.
[0058] If it is carried out according to an individual whenever calculation is a demand, the computed root weighting value will be used for a setup of the root so that it may explain later. Therefore, the root weighting value does not need to be saved. Depending on a radio communications system, a root weighting value is periodically computed for every link, and these calculation results are stored in the link condition preservation section 43 (step S122).
[0059] If a root weighting value is set to RootW, this is computable by the following (1) formula.
RootW=BER*BWK+1-/TrRate*TWK .... (1)
[0060] Here, BER is a bit error rate and BWK is the weighting multiplier of a bit error rate. Moreover, TrRate is the transfer rate of a packet and TWK is the weighting multiplier of a transfer rate. Moreover, sign * means addition. By this (1) formula, although the weighting multipliers BWK and TWK change by the arithmetic circuit which the wireless terminal 11 possesses, it is effective to consider as the value which can take the operation precision which is extent which cancellation of significant digits does not produce.
[0061] Moreover, in case these weighting multipliers BWK and TWK are set up, it is also effective to decide these values by for what kind of purpose a local network is used. For example, in a local network which thinks the effect on the communication link quality by the bit error rate as important, the weighting multipliers BWK and TWK will be set up so that the term of "BER*BWK" in (1) type may become a bigger value than the term of "1-/TrRate*TWK."
[0062] These weighting multipliers BWK and TWK are saved in the predetermined part in the detection result preservation section 22 shown in drawing 2 , and can also be used, and it may be made to perform the operation which sets up suitably in the case of the root retrieval explained below, and is shown in (1) type.
[0063] Drawing 12 expresses the condition at the time of there being a local network with a root weighting value. Here, the condition after the 6th wireless terminal 116 shown in drawing 8 participates in a local network is expressed. The figures from "1" to "8" described into the circle (O) like drawing 1 show the terminal address of a terminal proper, and the numeric values from "1" to "5" shown in the link 12 between the wireless terminals 11, respectively express the root weighting value.
[0064] Drawing 13 expresses the flow of the processing as which the terminal which starts a communication link determines the root and which is performed for accumulating. It explains as that to which the 1st wireless terminal 111 in drawing 12 starts radio to the 8th wireless terminal 118. For example, it is a case as the 1st wireless terminal 111 explained previously, so that the data about a schedule may be transmitted to the 8th wireless terminal 118. Since the 1st wireless terminal 111 is the side which starts data communication, when there is a demand of communication link initiation (step S131:Y), this 1st wireless terminal 111 will send out a root detection command. As already explained, before the 1st wireless terminal 111 publishes this root detection command, it is performing the negotiation of the transfer rate about each of the adjoining 2nd, 3rd, and 4th wireless terminals 112, 113, and 114, and bit error detection, saved each maximum transfer rate and a bit error rate in the transfer rate preservation section 41 and the bit error rate preservation section 42, and has updated these to the newest value.
[0065] The 1st wireless terminal 111 computes a root weighting value using these transfers rate and a bit error rate about each of the 2nd, 3rd, and 4th wireless terminals 112, 113, and 114 (step S132). Here, a root weighting value shall search the root where a smaller thing is better. As long as CPU which the information processing CPU unit 51 (drawing 3) within the 1st wireless terminal 111 described above always computes a root weighting value periodically and it saves in the predetermined part in the detection result preservation section 22, these contents may only be read.
[0066] The 1st wireless terminal 111 will choose the terminal which publishes a root find

command from the 2nd [which adjoins based on this], 3rd, and 4th wireless terminals 112, 113, and 114, if a root weighting value is computed (step S133). In this example, the number of these wireless terminals 11 is narrowed down to two. Therefore, a terminal with the smallest root weighting value and a terminal small next will be chosen.

[0067] If two terminals corresponding to such conditions are chosen as a root find command issue terminal (step S133), a root find command will be published by these wireless terminals 11 as an agency terminal (step S134). And the 1st wireless terminal 111 which published this command After the root which results in the 8th wireless terminal 118 as a result with which the procedure in which the wireless terminal 11 as an agency terminal sent out a root find command to the following wireless terminal 11 similarly was repeated is determined The retrieval root answerback sent from the wireless terminal 11 which adjoins as a result to which it is answered sequentially from this 8th wireless terminal 118 will be stood by (step S135). Then, in this example, data communication is performed between the 1st wireless terminal 111 and the 8th wireless terminal 118.

[0068] The retrieval routing section 37 shown in drawing 1 will perform selection of the terminal which publishes a root find command by the above explanation. The example shown in drawing 12 explains this. The 3rd wireless terminal 113 this value of whose is "1" has the smallest root weighting value among the 2nd [which sees and adjoins], 3rd, and 4th wireless terminals [terminal / 111 / 1st / wireless] 112, 113, and 114, and then the 4th wireless terminal 114 whose a value is "2" is small. Then, a root find command is published from the 1st wireless terminal 111 to these two wireless terminals 113 and 114.

[0069] If the 3rd wireless terminal 113 is looked at, it is going to publish a root find command to the 1st wireless terminal 111 and the 2nd wireless terminal 112 from the one where a root weighting value is smaller similarly. However, the 1st wireless terminal 111 is a terminal with which the root was already chosen. Therefore, the 1st wireless terminal 111 is excepted from a candidate. Consequently, the 3rd wireless terminal 113 will publish a root find command to the 2nd wireless terminal 112 and the 7th wireless terminal 117. As for the 4th wireless terminal 114, it is going to publish a root find command to the 1st wireless terminal 111 and the 7th wireless terminal 117 from the one where a root weighting value is smaller similarly. However, the 1st wireless terminal 111 is a terminal with which the root was already chosen similarly. Therefore, the 1st wireless terminal 111 is excepted from a candidate. Consequently, the 4th wireless terminal 114 will publish a root find command to the 7th wireless terminal 117 and the 3rd wireless terminal 113. Sequential selection of the terminal which publishes a root find command like the following will be made.

[0070] Drawing 14 generalizes and expresses signs that the root is set up, between the terminal which required the communication link, and a phase hand's terminal. Here, the terminal (the example currently explained above 1st wireless terminal 111) which is going to communicate is made into the end A of the beginning, and suffix A will be used for the sign showing the circuit apparatus etc. Moreover, A uses as the contiguity terminal B the adjoining terminal (the example currently explained above either of the 2nd, 3rd, and 4th wireless terminals 112, 113, and 114) which sends out a root find command, and uses suffix B for the sign showing that circuit apparatus etc. in this end of the beginning. Furthermore, a communicative phase hand's terminal (the example currently explained above 8th wireless terminal 118) is worn, it considers as Terminal C, and suffix C is used for the sign showing the circuit apparatus etc. Moreover, the terminal which wears with the contiguity terminal B and exists between Terminals C will be collectively expressed as a way station D.

[0071] Root find command sending-out section 36of A A sends out root find command 262A to the contiguity terminal B in the end of the beginning. At the contiguity terminal B, the retrieval routing section 37B chooses two root find command issue terminals similarly about the adjoining wireless terminal 11 on the basis of the end of a local. It becomes conditions that it is not the terminal already chosen at this time as explained previously. Root find command sending-out section 36B of the contiguity terminal B creates root find command 262B based on this, and sends it out to a way station D. It wears from the last way station D like the following, and root find command 262D is sent to retrieval routing section 37C of Terminal C.

[0072] It wears and Terminal C receives root find command 262D from every place. And the root which the optimal root was chosen [root] by the technique explained later, and had retrieval root answerback 263C showing the root chosen is sent out to a way station D in the returning form. A way station D sends this out to the contiguity terminal B. When the contiguity terminal B receives retrieval root answerback 263D, it will set this to retrieval root answerback 263B, and will send it to root find command sending-out section 36of A A in the end of the beginning. Thus, A wears, can know the most suitable root between Terminals C, will wear it along this determined root, and will start the communication link between Terminals C in the end of the beginning. In addition, the root find command sending-out section 36 shall be equipped not only with a transmitting function but with a reception function, respectively.
[0073] Thus, in the radio communications system which used the wireless terminal by this example, it wore, and finally the 8th [as a terminal C] wireless terminal 118 side chose the root, and has answered this to the 1st [as the end A of the beginning] wireless terminal 111 side. In order to make this possible, the root weighting adder unit 35 shown in drawing 2 is used.
[0074] It explains by returning to drawing 14 . The aggregate value of the address of the contiguity terminal B which performs data communication and along which was worn and it has passed in the beginning end of the transmitting origin of not only the address of Terminal C but a data packet for the address of A and root retrieval, and a way station D, and the weighting information on the root along which it has passed is included in root find command 262D which wears and is sent to retrieval routing section 37C of Terminal C. The address data contained in these roots find command 262D have the composition that the address of transmitting-to the beginning origin is arranged and are arranged at the sequence along which the address of a way station D has passed from the contiguity terminal B next, and a transmission place finally wears and the address of Terminal C is arranged. Therefore, the distribution root to which root find command 262D has been sent can be easily distinguished by reading the address of these single strings.
[0075] Drawing 15 expresses the procedure of processing the root find command by which each terminal has been sent to these. Each wireless terminal 11 is standing by reception of a root find command (step S141). Reception of a root find command extracts the address of the terminal (wearing terminal) which performs (Y) and data communication after this (step S142). And if this expresses the end of a local (step S143:Y), since that wireless terminal 11 will wear in this example and will turn into the 8th wireless terminal 118 as a terminal, retrieval root answerback processing in which it explains later will be performed (step S144).
[0076] On the other hand, in the case of this example, the wireless terminal 11 of plurality (this example two) which adjoins in order to wear, and to relay (step S143:N) and this root find command, in not being the 8th wireless terminal 118 as a terminal, either is chosen (step S145). The terminal these-chosen has a small root weighting value. The sent root weighting value is added to the root weighting value of the selected wireless terminal 11. If the wireless terminal 11 of the following path is chosen as mentioned above, when it searches the same root, the check of whether to be the wireless terminal 11 with which the root was already chosen will be performed (step S146). This is consideration in which it is made for the root formed in the process in which the wireless terminal 11 to relay chooses the following wireless terminal 11 further not to form a closed loop. When the terminal which already published the root find command is included, it will be excepted and then the wireless terminal 11 with a small root weighting value will be added.
[0077] The wireless terminal 11 which received the root find command as mentioned above will publish a root find command to the terminal chosen at step S145 (step S147). Since it serves as plurality every wireless terminal 11 which processes drawing 15 , the number of the terminals with which a root find command is published also increases it in principle, so that the wireless terminal 11 with which a root find command is published has many junction paths.
[0078] It wears and drawing 16 expresses the flow of retrieval root answerback processing by the terminal shown at step S144. Although the 8th wireless terminal 118 wears and it is a terminal in this example, each wireless terminal 11 of it corresponding to this equally which constitutes a local network is natural. The wireless terminal 11 collects the root find commands

of the same transmitting origin (step S151). And collection of the root find command of these same transmitting origin is continued until the predetermined time amount t passes in consideration of the time amount which spreads a local network, after a transmitting agency publishes a root find command first (step S152). However, time amount t does not need to take into consideration even arrival of the root find command which passed through the worst (longest) root. It is because it is the main point which chooses the root good originally. Therefore, a total may be closed, when a total is closed by time amount t and the root find command from the same transmitting origin except reaches the number defined beforehand.

[0079] Thus, if a total is terminated by a certain technique, total of a root weighting value will choose the smallest root (step S153). And retrieval root answerback which shows this root is performed to a transmitting agency (step S154). As step S135 of drawing 13 showed, the wireless terminal 11 which starts a communication link will receive this retrieval root answerback, and will start a communication link by the determined root. Thereby in a previous example, the communication link of the 1st wireless terminal 111 and the 8th wireless terminal 118 is attained.

[0080] In addition, although the terminal to relay publishes a root find command to the next destination at step S147 of drawing 15 , the case where that terminal has left the local network at this time can be made into possibility. Especially the processing in such a case does not pose a problem. It is because such the cut root of that to which the root followed one by one with much trouble from the wireless terminal 11 which starts a communication link will go out at this time is not applicable to a communication link from the first, so there are no implications which continue those processings.

[0081] Finally, after a communication link is started, the case where the wireless terminal 11 which exists on the root leaves a local network is explained. What is necessary is just to choose the root which does not go via such a wireless terminal 11, when some wireless terminals 11 leave a local network in the phase of setting up the root before starting a communication link. However, when the wireless terminal 11 on the root secedes to the midst to which the communication link is performed, it is because it is necessary to reconfigurate the root.

[0082] Drawing 17 shows an example to which the terminal in the middle of the root where the communication link is performed leaves a local network. The root for a communication link is set up between the 1st wireless terminal 111 and the 8th wireless terminal 118 also in the example shown in this drawing. When the path is followed in order, they are the 1st wireless terminal 111, the 2nd wireless terminal 112, the 5th wireless terminal 115, the 6th wireless terminal 116, and the 8th wireless terminal 118. If the 5th wireless terminal 115 moves to the location which an electric wave does not reach here or the power source is disconnected by a certain reason, a link will disappear. It becomes impossible thereby, to communicate the 1st wireless terminal 111 and the 8th wireless terminal 118 by the root which was communicating at the beginning.

[0083] If it becomes such a situation, the 2nd wireless terminal 112 and the 6th wireless terminal 116 contiguous to the 5th wireless terminal 115 will be set as "infinity" (infinity) like illustration of the weighting value of the link between these and the 5th wireless terminal 115. And the 2nd wireless terminal 112 sends out the data packet which shows that the selected root is no longer used to the 1st wireless terminal 111 instead of otherwise transmitting the data packet sent from the 1st wireless terminal 111. The root which newly results in the 8th wireless terminal 118 will be searched with the same procedure with having explained the 1st wireless terminal 111 previously based on this.

[0084] Drawing 18 expresses the flow of processing of each terminal by the side of the junction after communication link initiation. It distinguishes whether the wireless terminal 11 has the reception response to a data packet from a contiguity terminal, when a data packet is transmitted to a contiguity terminal (step S161) (step S162). If there is a reception response, a data packet is sent out to (Y) and its wireless terminal 11 (step S163).

[0085] On the other hand, when there is no reception response and the following terminal shows that sending out of the data packet to this is impossible, the weighting value of the link between (step S162:N) and its wireless terminal 11 is changed into "infinity" (step S164). And it distinguishes whether the weighting value of a link in a direction is "infinity" the side (this

example 1st wireless terminal 111) which made the communication link start (step S165). If it is "infinity", processing will be ended, without [(Y) and] performing anything (end). This is for wearing the data packet which shows that the root where the 6th wireless terminal 116 side was chosen to the data packet sent from the 8th wireless terminal 118 in this example is no longer used, and making it not make it send out to the 8th wireless terminal 118 as a terminal. It is because the both sides of the 1st wireless terminal 111 and the 8th wireless terminal 118 will search the root as a result when such a data packet is sent out.

[0086] The data packet which will make the destination the wireless terminal 11 with the next wireless terminal 11 of the side which it saw [side] from the wireless terminal 11 under processing at step S165, and made the communication link start which made (N) and a communication link start if the weighting value of a link is not "infinity" will be sent out (step S166). In addition, also when the wireless terminal 11 intervenes partly on the way, these wireless terminals 11 perform processing shown in drawing 18 , and make that packet spread one after another in a local network, although this data packet will be directly sent to the 1st wireless terminal 111 in this example.

[0087] The modification of invention [0088] Drawing 19 expresses the configuration of the wireless terminal in the modification of this invention. The same sign is given to the same part as drawing 2 of a previous example, and these explanation is omitted suitably. The wireless terminal 71 of this modification is equivalent to each wireless terminals 111-118 of a previous example. The wireless terminal 71 is equipped with the parameter detecting element 72 which detects the various parameters at the time of performing routing between the terminal of data transmitting origin, and the terminal of the arbitration of a data transmission place by the wireless local network as shown in drawing 1 , and the detection result preservation section 73 for saving various detection results. The parameter detecting element 72 has the composition of having added the amount detecting element 74 of delay to each circuit apparatus inside the parameter detecting element 21 shown in drawing 2 . Moreover, the detection result preservation section 73 has the composition of having added the amount preservation section 75 of delay to each circuit apparatus inside [which was shown in drawing 2] the detection result preservation section 22.

[0089] Here, the amount detecting element 74 of delay is a unit to detect the amount of processing delay of each wireless terminal, in case the wireless terminal which exists in each junction point between a phase hand's wireless terminals the transmitting origin of a data packet relays a root find command. The amount of delay which this amount detecting element 74 of delay detected is saved in the amount preservation section 75 of delay in the detection result preservation section 73.

[0090] Drawing 20 shows the case where it is the simple configuration that the root is formed among three wireless terminals as an example. Here, the terminal which is going to communicate is set to end of the beginning 71A, and a communicative phase hand's terminal is worn and it is referred to as terminal 71C. Moreover, the terminal which adjoins 71A in the end of the beginning is set to contiguity terminal (or junction terminal) 71B. The data packet which 71A emitted in the end of the beginning shall wear through contiguity terminal 71B, and shall be transmitted to terminal 71C.

[0091] Suppose that the time delay for n seconds will arise by the time it wears after contiguity terminal 71B receives the data forwarding instruction from end of the beginning 71A, and it transmits a data forwarding instruction similarly to terminal 71C. In such a case, the actual transfer rate RTrRate (bits per second) to the schedule transfer rate TrRate (bits per second) determined by the transfer rate negotiation section 31 (drawing 19) can be expressed with the following (2) types.

[0092]

RTrRate=TrRate/(1+n) (bits per second) .... (2)

[0093] The root weighting value at the time of taking the amount of delay into consideration now is set to RootWD, and a schedule transfer rate is set to TrRateD. Moreover, the amount of delay of contiguity terminal (or junction terminal) 71B is set to TrD, a bit error rate is set to BER, and the weighting multiplier of TWK and a bit error rate is set to BWK for the weighting multiplier of a

transfer rate. The weighting value of the root in this case is calculated by the following (3) types.

[0094]
RootWD=BER*BW/(TrRateD/(1+TrD)) *TWK .... (3)
[0095] Therefore, retrieval of the optimal root which considered data transfer delay of contiguity terminal (or junction terminal) 71B is attained by setting up a root weighting value in consideration of the amount of delay.
[0096] In addition, the example and modification which were explained above cannot be restricted to ad hoc, and can be applied like other radio communications systems which use each wireless terminal also as a junction terminal.
[0097]
[Effect of the Invention] Since according to invention according to claim 1 to 6 the weighting value of the channel by which the terminal transmitted one after another sends out a root retrieval demand to a degree is added and it transmits as explained above, a communicative phase hand can distinguish easily which root is the optimal based on a weighting value old in the phase which received the root retrieval demand. Therefore, quick retrieval of the root is not only attained, but by the side which starts a communication link, retrieval processing of the root becomes easy.
[0098] Moreover, a bit error rate measurement means to measure the bit error rate of each channel which was connected to other terminals which adjoin an end according to invention according to claim 2, Since a transfer rate setting means to set up the data transfer rate which was connected to other terminals which adjoin an end and which used those channels for every channel was established A weighting value can be set up using a bit error rate and a data transfer rate, and the proper root can be chosen from the both sides of transmission speed and the dependability of data.
[0099] Furthermore, since the wireless terminal was made to possess a notice means at the time of communication link [which notifies this to the terminal which started the communication link using the remainder of the root which the root decision means determined] improper according to invention according to claim 3 when it became impossible to use the channel to which a data junction means sends out data When a communication link becomes impossible, this can be notified to the terminal which started the communication link, and resetting of the root is attained if needed. Also in this case, the action with them is possible. [there are few burdens of the terminal of the side which resumes a communication link, and prompt]
[0100] Moreover, since the weighting value added to a root retrieval demand is an aggregate value of the weighting value of each channel via which it went from the transmitting origin of a root retrieval demand according to invention according to claim 4, a root decision means can be determined by comparing the magnitude of this aggregate value simply.
[0101] Furthermore, since it was made not to choose the already chosen channel again according to invention according to claim 5 when choosing a channel one after another and setting up the root, it not only prevents selection of a path which forms a closed loop in this side which reaches a communicative phase hand, but effectiveness is in reduction in traffic.
[0102] Moreover, according to invention according to claim 6, since a root decision means determines the optimal root using a duration until a root retrieval demand is received through each root with a weighting value, practical routing based on an actual transmission speed becomes possible.

[Translation done.]

* NOTICES *

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TECHNICAL FIELD

[Field of the Invention] Especially this invention relates to the wireless terminal which can set up the root between the terminals of the phase hand who communicates by the local network with respect to a wireless terminal.

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PRIOR ART

[Description of the Prior Art] Wireless terminals, such as a personal digital assistant, have spread broadly, and attentions have gathered also for the local communication link of these wireless terminals with this. The typical thing of such a local network is an ad hoc (ad hoc) network. An ad hoc network is a local network created temporarily if needed, and the wireless terminal which constitutes a network does not know a mutual existence in advance. Moreover, the server which manages these networks intensively does not exist. Each wireless terminal does not need a special setup for a communication link, but can recognize a surrounding wireless terminal autonomously, can build a network, and can do informational exchange and an informational share. For this reason, it may say that the wireless terminal which existed on the network leaves suddenly, and the structure which can be adapted to such change is searched for.
[0003] In case such a local network is formed, via what kind of wireless terminal data are transmitted to other wireless terminals poses a problem from a certain wireless terminal. In transmitting and receiving data between computers generally, it transmits IP data from the IP address of arbitration to IP (Internet Protocol) address of the destination using a routing protocol by the network layer in OSI (Open System Interconnection: open systems interconnection). In this case, the 1st technique of adopting distance vector routing made into the conditions of selection of distance as a routing protocol for routing to be used and the 2nd technique of adopting link state-vector routing made into the conditions of selection of a link condition exist.
[0004] In distance vector routing as the 1st technique of these, the pop number as the number of counts of the gateway hop as an element which determines the delivery root of IP datagram is used, and the distance vector is computed. And the root is determined because a distance vector chooses a short path. A pop number means the number of the gateways which will meet by the time IP datagram reaches even to the destination terminal connected to other LANs from the starting point connected to a certain LAN (Local Area Network) here.
[0005] He maps the information which shows whether the link between the approaching gateways is usable, and is trying to apply the Dijkstra (Djikstra) algorithm as an algorithm of the network shortest path planning in routing using the link state vector as the 2nd technique. In this case, he is trying to calculate the minimum distance over all ending points from the one starting point.
[0006] On the other hand, the various proposals of the technique or technique about routing are made besides this. For example, whenever it receives the error packet generated when distance vector routing as the 1st technique is applied and the life time of the packet signal for retrieval expires, he is trying to make the number of hop increase by the 3rd technique proposed by JP,2000-49852,A. That is, by this proposal, the priority of the path to choose is changed by making a distance vector increase.
[0007] Moreover, what was proposed by JP,2000-341199,A as the 4th technique exists. He chooses a communication path using two or more communication-path information that priority was attached beforehand, and is trying to build a network system by this 4th technique. And when an error occurs in one of communication paths, he is trying to return the data which added

this error information to a transmitting agency. If error information is received, he is trying not to reduce communication link efficiency to the degree of the path information which he has by changing to the high communication path of priority at a transmitting agency.
[0008] Furthermore, the 5th technique which was proposed by JP,2000-4469,A also exists. This 5th technique is applied to the radio communications system which consists of a center station, two or more junction nodes, and two or more wireless terminals. By this technique, a center station outputs an adjustment demand signal and a wireless terminal receives this through a junction node. A wireless terminal is transmitted by the radio wave by return [quality information /, such as received field strength and a bit error rate,]. In two or more above mentioned junction nodes which received the radio wave of this wireless terminal, the receiving quality information of a radio wave is added to this, and it transmits to a center station.

[Translation done.]

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EFFECT OF THE INVENTION

[Effect of the Invention] Since according to invention according to claim 1 to 6 the weighting value of the channel by which the terminal transmitted one after another sends out a root retrieval demand to a degree is added and it transmits as explained above, a communicative phase hand can distinguish easily which root is the optimal based on a weighting value old in the phase which received the root retrieval demand. Therefore, quick retrieval of the root is not only attained, but by the side which starts a communication link, retrieval processing of the root becomes easy.
[0098] Moreover, a bit error rate measurement means to measure the bit error rate of each channel which was connected to other terminals which adjoin an end according to invention according to claim 2, Since a transfer rate setting means to set up the data transfer rate which was connected to other terminals which adjoin an end and which used those channels for every channel was established A weighting value can be set up using a bit error rate and a data transfer rate, and the proper root can be chosen from the both sides of transmission speed and the dependability of data.
[0099] Furthermore, since the wireless terminal was made to possess a notice means at the time of communication link [which notifies this to the terminal which started the communication link using the remainder of the root which the root decision means determined] improper according to invention according to claim 3 when it became impossible to use the channel to which a data junction means sends out data When a communication link becomes impossible, this can be notified to the terminal which started the communication link, and resetting of the root is attained if needed. Also in this case, the action with them is possible. [there are few burdens of the terminal of the side which resumes a communication link, and prompt]
[0100] Moreover, since the weighting value added to a root retrieval demand is an aggregate value of the weighting value of each channel via which it went from the transmitting origin of a root retrieval demand according to invention according to claim 4, a root decision means can be determined by comparing the magnitude of this aggregate value simply.
[0101] Furthermore, since it was made not to choose the already chosen channel again according to invention according to claim 5 when choosing a channel one after another and setting up the root, it not only prevents selection of a path which forms a closed loop in this side which reaches a communicative phase hand, but effectiveness is in reduction in traffic.
[0102] Moreover, according to invention according to claim 6, since a root decision means determines the optimal root using a duration until a root retrieval demand is received through each root with a weighting value, practical routing based on an actual transmission speed becomes possible.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the way, a network situation tends to change as compared with the channel according [the channel which used wireless] to a cable. For example, field strength not only always changes with time amount, but produces the phenomenon of phasing. Phasing is the fluctuation phenomenon of a carrier frequency in which interfere mutually and the strength changes here, when an electric wave causes reflection, diffraction, and dispersion with a building, a tree, etc. The transceiver error of data may occur from a transmitting agency to a reception place by considering these change of a situation as a cause. Extent of a transceiver error appears as a bit error rate. If a bit error rate is above high to some extent, a communication link will become impossible and the accident in which a communication link is cut will occur. Thus, a communicative transfer rate is important for the communication link quality in radio, and the quality judging by the bit error rate also becomes important.
[0010] For this reason, even if various kinds of proposals which were explained above tended to apply to local networks, such as an ad hoc network, as it is, that application was difficult for them. This is explained below.
[0011] First, the 1st technique is looked at. If it limits when computing vector distance to a static network, a problem will not produce especially this technique. It is because it is comparatively easy to create a path table about all termination. However, the 1st technique is not suitable in being an already explained local network like an ad hoc network. In a local network, it is because it is not realistic to create a path table about all termination in order to redo path retrieval of plurality whenever the wireless terminal which was relaying data interchanges, as already explained and for the path retrieval itself to take time amount moreover.

[0012] Routing using the link state vector as the 2nd technique covers the fault of the routing processing by the distance vector in the 1st technique. That is, the path retrieval by the link state vector judges whether the adjoining gateway and a communication link are possible, by this, creates a root map and calculates the minimum distance to each root. However, if the local network by wireless, such as an ad hoc network without the gateway of dedication, is constituted using this 2nd technique, it will become difficult to search the optimal path. In the network by the radio which changes by time amount with network comparatively short quality, it is because the optimal path cannot be searched only with a link information.
[0013] Whenever it receives an error packet as an application form of a distance vector, he is trying to make the number of hop increase by the 3rd technique on the other hand. Thus, it is effective to lower the priority of the path chosen by making the number of hop increase, and to choose the optimal root in the usual network. However, at the local network of the character in which network quality changes to comparatively short time amount, for example under the mobile environment, the optimal path cannot be chosen only by the technique of making the number of hop increase and lowering priority with the passage of time.
[0014] Next, the 4th technique is considered. When an error occurs, it is made to correspond to a communication link situation by changing to the communication path of the following priority by this 4th technique. However, it is the information about the priority saved beforehand which is chosen as following priority. Therefore, as described above, in changing by time amount with

network comparatively short quality, what was distinguished based on the saved information as it is the following ranking not necessarily shows the optimal path at the time.
[0015] Finally the 5th technique is considered. In case routing is performed using field strength and a bit error and the communication link with a relay center is performed to the terminal of arbitration, it enables it to choose the Communication Bureau with sufficient communication link quality by the 5th technique. However, if it is going to apply this technique when a wireless terminal plays a role of a relay center in coincidence like an ad hoc network, unlike the communication configuration of one-pair plurality of a relay center and a wireless terminal, more than one will become the communication link of opposite plurality. Therefore, the root cannot be searched using this 5th technique.
[0016] Then, the purposes of this invention are local networks, such as an ad hoc network, and are to offer the wireless terminal with which the optimal root required for a communication link can be searched in a short time.

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MEANS

[Means for Solving the Problem] A weighting value setting means to set up the weighting value as a reference value of the selection at the time of communicating using these channels for each [which was connected to other terminals which adjoin a (b) end in invention according to claim 1] channel of every, When it comes in the form where the root retrieval demand for setting up the root of the communication link which used the predetermined terminal as the communicative phase hand from the terminal of (b) others added the weighting value of the channel via which it went till then, A root retrieval demand junction means to send out to the predetermined channel which referred to the weighting value of each channel connected to this on the basis of the end of a local, and was chosen from from among these channels in the form where the weighting value of the channel was added, (Ha) When the root retrieval demand which used the end of a local as the communicative phase hand comes a root decision means to determine the optimal root based on the weighting value of the added channel via which it went till then, and (d) — a wireless terminal is made to possess a notice means of a root retrieval result to notify the root determined by this root decision means to the sending-out origin of a root retrieval demand
[0018] That is, in invention according to claim 1, the weighting value as a reference value of the selection at the time of communicating using these channels for each [by which the wireless terminal was connected to other terminals which adjoin an end] channel of every is set up. and when the root retrieval demand for setting up the root of the communication link which used the predetermined terminal as the communicative phase hand from other terminals comes While choosing some of the channels which refer to a weighting value and are connected in the end of a local, a root retrieval demand is sent out to the channel these-chosen as the weighting value of the old channel added and sent to the root retrieval demand in the form where the weighting value of this channel was added. Thus, when the root retrieval demand is sent, the root retrieval demand of **** will be sent to a communicative phase hand at last. When a root retrieval demand comes, he is trying to determine the optimal root by the communicative phase hand based on the weighting value of the added channel via which it went till then. And he is trying to tell the side which starts a communication link about this root with the notice means of a root retrieval result. Thus, in invention according to claim 1, since the root can be determined when a root retrieval demand is sent to a communicative phase hand, quick retrieval of the root is attained. Moreover, in the side which starts a communication link, retrieval processing of the root becomes easy.
[0019] A bit error rate measurement means to measure the bit error rate of each channel connected to other terminals which adjoin a (b) end in invention according to claim 2, A transfer rate setting means to set up the above mentioned data transfer rate which was connected to other terminals which adjoin a (b) end and which used those channels for every channel, A weighting value setting means to set up the weighting value as a reference value for setting up the root of the communication link performed between a phase hand's terminals using each channel based on measurement and the contents of a setting of these bit error rate measurement means and the transfer rate setting means, (Ha) A root retrieval demand sending-out means to send out the root retrieval demand which added those weighting values to each

channel connected to this on the basis of the end of a local when starting a communication link after choosing the root as the method of a course of the channel between (d) predetermined phase hands, When it comes in the form where the (e) root retrieval demand added the weighting value of the channel via which it went till then, A root retrieval demand junction means to send out to the predetermined channel which referred to the weighting value of each channel connected to this on the basis of the end of a local, and was chosen from from among these channels in the form where the weighting value of the channel was added, (Passing) When the root retrieval demand which used the end of a local as the communicative phase hand comes A root decision means to determine the optimal root based on the weighting value of the added channel via which it went till then, (g) When the notice by this notice means of a root retrieval result comes to the notice means [to notify the root determined by this root decision means to the sending-out origin of a root retrieval demand] of root retrieval result, and sending-out origin of a (h) root retrieval demand, A wireless terminal is made to possess a communication link initiation means to start a communication link to a communicative phase hand according to the root shown in this.

[0020] That is, in invention according to claim 2, the weighting value as a reference value of the selection at the time of communicating using these channels for each [by which the wireless terminal was connected to other terminals which adjoin an end] channel of every is set up. The measurement result of the bit error rate of each channel to which the end of a local and end by the bit error rate measurement means were connected, and the setting result of the data transfer rate to which the end of a local and end by the transfer rate setting means were connected and which used those channels for every channel are used for a setup of a weighting value. A data transfer rate may be decided by the negotiation between the terminals which counter through a channel. In invention according to claim 2, it has the root retrieval demand sending-out means. A root retrieval demand sending-out means is a means to send out the root retrieval demand which added those weighting values to each channel connected to this on the basis of the end of a local, when starting a communication link after a wireless terminal chooses the root as the method of a course of the channel between predetermined phase hands. Although a root retrieval demand is sent to a communicative phase hand via a channel, the terminal which acts as intermediary then adds the weighting value about the channel, when sending out a root retrieval demand to a channel, while referring to these weighting values about selection of the channel on the basis of the end of a local. A communicative phase hand will determine the optimal root based on the weighting value of each old channel, when the root retrieval demand has been sent. The notice means of a root retrieval result will notify the root determined by this root decision means to the sending-out origin of a root retrieval demand. Based on this, a communication link initiation means will start a communication link to a communicative phase hand according to the notified root. Thus, in invention according to claim 2, since the root can be determined when a root retrieval demand is sent to a communicative phase hand, quick retrieval of the root is attained. Moreover, in the side which starts a communication link, retrieval processing of the root becomes easy. Furthermore, since the weighting value is set up using a bit error rate and a data transfer rate, the proper root can be chosen from the both sides of transmission speed and the dependability of data.

[0021] A weighting value setting means to set up the weighting value as a reference value of the selection at the time of communicating using these channels for each [which was connected to other terminals which adjoin a (b) end in invention according to claim 3] channel of every, A root retrieval demand sending-out means to send out the root retrieval demand which added those weighting values to each channel connected to this on the basis of the end of a local when starting a communication link after choosing the root as the method of a course of the channel between (b) predetermined phase hands, When it comes in the form where the root retrieval demand added the weighting value of the channel via which it went till then, (Ha) A root retrieval demand junction means to send out to the predetermined channel which referred to the weighting value of each channel connected to this on the basis of the end of a local, and was chosen from from among these channels in the form where the weighting value of the channel was added, When the root retrieval demand which used the end of a (d) local as the

communicative phase hand comes A root decision means to determine the optimal root based on the weighting value of the added channel via which it went till then, (**), when the notice by this notice means of a root retrieval result comes to the sending-out origin of a root retrieval demand in **, a notice means of a root retrieval result to notify the root determined by this root decision means to the sending-out origin of a root retrieval demand, and A communication link initiation means to start a communication link to a communicative phase hand according to the root shown in this, A data junction means by which the sending-out origin of a (g) root retrieval demand sends out the data sent out after root decision to the following channel according to this root, (h) When it becomes impossible to use the channel to which this data junction means sends out data, a wireless terminal is made to possess a notice means at the time of communication link [which notifies this to the terminal which started the communication link using the remainder of the root which the root decision means determined] improper.

[0022] That is, in invention according to claim 3, the weighting value as a reference value of the selection at the time of communicating using these channels for each [by which the wireless terminal was connected to other terminals which adjoin an end] channel of every is set up. and when the root retrieval demand for setting up the root of the communication link which used the predetermined terminal as the communicative phase hand from other terminals comes While choosing some of the channels which refer to a weighting value and are connected in the end of a local, a root retrieval demand is sent out to the channel these-chosen as the weighting value of the old channel added and sent to the root retrieval demand in the form where the weighting value of this channel was added. Thus, when the root retrieval demand is sent, the root retrieval demand of **** will be sent to a communicative phase hand at last. When a root retrieval demand comes, he is trying to determine the optimal root by the communicative phase hand based on the weighting value of the added channel via which it went till then. And the side which starts a communication link is told about this root with the notice means of a root retrieval result, and communicative initiation is enabled with the communication link initiation means. However, even if a communication link is started, the terminal which has become a part of root moves, and there is a case where it becomes impossible to use the channel to which a data junction means sends out data by the reason of junction becoming impossible etc. Resetting of the root is attained if needed by using the part of the near root where the corresponding terminal does not exist, when such, and notifying this to the terminal with which the notice means started the communication link at the time of communication link improper. Also in this case, the action with them is possible. [there are few burdens of the terminal of the side which resumes a communication link, and prompt]

[0023] invention according to claim 4 — claim 1 - claim 3 — the weighting value added to a root retrieval demand at a wireless terminal given in either is an aggregate value of the weighting value of each channel via which it went from the sending-out origin of a root retrieval demand, and the root decision means is characterized by determining the optimal root based on the magnitude of this aggregate value.

[0024] That is, in invention according to claim 4, since the weighting value added to a root retrieval demand is an aggregate value of the weighting value of each channel via which it went from the sending-out origin of a root retrieval demand, it can shorten data lengths, such as a packet sent out rather than the case where each value is added and sent out according to an individual. Moreover, by the communicative phase hand, the optimal root can be easily distinguished from the smallest thing or the largest thing of this aggregate value. In addition, respectively with [the weighting value of each channel] one [or more], integrating instead of addition is also possible.

[0025] invention according to claim 5 — claim 1 - claim 3 — the root retrieval demand junction means is characterized by acting as intermediary by choosing channels other than the channel already chosen with reference to the root sent with the root retrieval demand at the wireless terminal given in either.

[0026] That is, by invention according to claim 5, selection of a path which forms a closed loop in this side which reaches a communicative phase hand is prevented by making it not choose the already chosen channel again, when choosing a channel one after another and setting up the

root.
[0027] invention according to claim 6 — claim 1 – claim 3 — as for a root decision means, a root retrieval demand should pass each root with a weighting value at a wireless terminal given in either — it is characterized by determining the optimal root using a duration until it is received.
[0028] That is, by invention according to claim 6, realistic routing is made possible by taking into consideration the time amount which the communication link of a root retrieval demand etc. actually takes.
[0029]
[Embodiment of the Invention]

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EXAMPLE

[Example] This invention is explained to a detail per example below.
[0031] Drawing 1 shows the local network applied in the one example of this invention. As shown in this drawing, two or more wireless terminals 111-118 shall exist in the comparatively narrow field. The figures from "1" to "8" described into the circle (O) which shows each wireless terminal 111-118 shall show the terminal address of these terminal propers. The 5th wireless terminal 115 moves from other locations, and this drawing shows the condition of having participated in this local network. The straight line which ties each wireless terminals 111-118 expresses the mutual link 12. When the 5th wireless terminal 115 participates in a network in this example, the link 12 for performing the communication link of other wireless terminals 11 in this network and data will be stretched. On the contrary, if the 8th wireless terminal 118 secedes from a network, that link 12 will be canceled at this time. Therefore, the wireless terminal 11 which was communicating using the canceled link 12 needs to use other links 12.
[0032] Drawing 2 expresses functionally the circuitry of the wireless terminal which participates in this local network. although the circuitry of the 5th wireless terminal 115 was shown here -- the 1- the 4th wireless terminal 111-114 and the 6- the functional configuration of the circuit of the 8th wireless terminal 116-118 is also fundamentally the same as that of this.
[0033] The 5th wireless terminal 115 is equipped with the parameter detecting element 21 which detects the various parameters at the time of performing routing between the terminal of data transmitting origin, and the terminal of the arbitration of a data transmission place by the wireless local network as shown in drawing 1 , and the detection result preservation section 22 for saving various detection results. The transfer rate negotiation section 31 to which the parameter detecting element 21 carries out the negotiation of the transfer rate with the terminal which transmits a packet, The bit error rate detecting element 32 which detects the bit error rate for the communication link with this terminal, The link condition detecting element 33 for checking the existence of the link between each adjoining terminal (connection), The routing weighting calculation section 34 which computes weighting for although routing is performed with the detected bit rate and a transfer rate, The root weighting adder unit 35 which carries out sequential addition of the result of weighting in case routing is performed, The root find command sending-out section 36 which sends out the root find command for performing root retrieval in case it communicates, It passes along the retrieval routing section 37 which chooses the searched optimal root, the retrieval root answerback section 38 which performs answerback for returning this optimal root to the terminal which published the find command, and the selected root. It has the routing-data transfer section 39 which transmits routing data for the terminal located in the middle to transmit the data of a transmitting agency to a destination terminal.
[0034] The transfer rate preservation section 41 where the detection result preservation section 22, on the other hand, saves the transfer rate as a result of the negotiation in the transfer rate negotiation section 31 in the parameter detecting element 21, The bit error rate preservation section 42 which saves the bit error rate which the bit error rate detecting element 32 detected, The link condition preservation section 43 which saves the current link condition which the link condition detecting element 33 detected, the 1- the 4th wireless terminal 111-114 and the 6-

with the terminal address preservation section 44 which saves the terminal address original with the 5th wireless terminal 115 which does not lap with the 8th wireless terminal 116-118 as the self address It has the retrieval root preservation section 45 which saves the optimal root as a result of retrieval.

[0035] Drawing 3 shows the outline of the circuitry of the 5th wireless terminal equipped with such a functional configuration. Moreover, drawing 4 and drawing 5 express still more concretely the important section of the circuit of this 5th wireless terminal. the 1- the 4th wireless terminal 111-114 and the 6- since it is fundamentally the same, the circuitry of the 8th wireless terminal 116-118 also abbreviates the explanation about these to these drawings.

[0036] The 5th wireless terminal 115 is equipped with the information processing CPU (central processing unit) unit 51 for performing various control as shown in drawing 3 . The information processing CPU unit 51 is constituted by timer 51C, interrupt controller 51D, and bus controller 51E connected to CPU(central processing unit)51A and this CPU51A by internal bus 51B as shown in drawing 4 . Here, interrupt controller 51D has connected interrupt control-line 51F, and receives interruption to CPU51A. Although timer 51C is the hardware for a time check, it can also instead consist of software using the control program which counts a clock. Bus controller 51E has connected Maine Bath 52 for connecting other circuit apparatus with the information processing CPU unit 51 shown in drawing 3 .

[0037] It returns to drawing 3 and explanation is continued. The information processing CPU unit 51 has connected the 1st oscillator 50 which receives supply of a clock signal. The information processing CPU unit 51 is connected with each part within a terminal through Maine Bath 52. Among these, the memory unit 53 consists of ROM53A and RAM53B, as shown in drawing 5 . ROM53A is the read only memory which stored required fixed data while storing the control program which CPU51A shown in drawing 4 performs. RAM53B is for saving temporary data, such as progress of an operation when various data processing is performed or CPU51A processes retrieval of the root etc. based on this control program, and a processing result, and is constituted by random access memory.

[0038] The I/O (I/O) control unit 54 in drawing 3 has connected the key input section 55, and performs interface conversion with this and Maine Bath. The key input section 55 is a part used as the user interface that a user starts retrieval processing of a terminal.

[0039] The display unit 56 is equipment which displays visual data, such as various processing results. A communications control unit 57 controls the communication link with other wireless terminals, and has connected the RF (Radio Frequency: radio frequency) unit 59 which connected the antenna 58 in this example. The RF unit 59 is a circuit which performs magnification and detection of an analog radio signal, and an antenna 58 transmits and receives an analog radio signal here. The 2nd oscillator 61 is connected to the RF unit 59, and the 3rd oscillator 62 is connected to the communications control unit 57, respectively, and a predetermined dispatch output is supplied. It connects with interrupt control-line 51F shown by drawing 4 , and the information processing CPU unit 51 receives required interrupt control.

[0040] Each circuit in the detection result preservation section 22 of the transfer rate preservation section 41 grade shown by drawing 2 is constituted using each field of RAM53B in the memory unit 53. Moreover, the parameter detecting element 21 is constituted by the information processing CPU unit 51 and the RF unit 59 grade.

[0041] Drawing 6 and drawing 7 express the flow in the phase of the beginning of processing in case one of the wireless terminals of a configuration as explained above participates in a local network. As an example, in order that the 6th wireless terminal 116 may start a communication link between the 1st wireless terminal 111, it may participate in a local network. For example, it is a case so that application which transmits the data about the schedule by which the 6th wireless terminal 116 is stored in self equipment to the 1st wireless terminal 111 may be started. Of course, as shown in drawing 1 , the 6th wireless terminal 116 may approach this local network that consists of the 5th wireless terminal 115 grade, and it may participate in this by a certain reason.

[0042] In such a case, to the terminal which is located in the perimeter and can relay a packet to other terminals, the 6th wireless terminal 116 will send out a terminal retrieval demand, and will

try connection. Even when the 6th wireless terminal 116 tries a communication link between the 1st wireless terminal 111 In order to make a communication link start to the 1st wireless terminal 111 which is not understood through what kind of the root I may communicate at the time Send out the demand which connects with the terminal near a local station first, and is connected with the 1st wireless terminal 111 to these terminals, and when these terminals are not the 1st wireless terminal 111 It is because it is finally necessary to transmit the demand to the 1st wireless terminal 111, making other terminals spread the same demand one after another.

[0043] The 6th wireless terminal 116 sends out a terminal retrieval demand to the perimeter with hand control or automatic first (drawing 6 step S101). The self-address of the 6th wireless terminal 116 as a connection-request terminal is included in the terminal retrieval demand. The retrieval by hand control is the case where retrieval is performed intentionally, in order that the user of the 6th wireless terminal 116 may discover the community which forms the local network and may connect with the community. On the other hand, the retrieval by automatic is the case where the set of timer 51C shown in drawing 4 searches periodically for every fixed time amount to the 6th wireless terminal 116.

[0044] Drawing 8 expresses the condition that the 6th wireless terminal tries the wireless terminal of the perimeter, and connection. In this example, the 5th, 3rd, 7th, and 8th wireless terminals 115, 113, 117, and 118 exist in the range which the wireless of the 6th wireless terminal 116 reaches. Therefore, answerback may come by the example shown in this drawing 8 from these terminals. In order to simplify explanation, the case where there is answerback from the 5th wireless terminal 115 is explained.

[0045] The 5th wireless terminal 115 sends out the self-address of a connected terminal, i.e., the self-address of the 5th wireless terminal 115, as a connection-confirm response to this 6th wireless terminal 116 as a connection-request terminal, if a terminal retrieval demand of the 6th wireless terminal 116 is received (step S102). The 6th wireless terminal 116 is that the self-address of the 5th wireless terminal 115 comes to hand, and it means that the wireless terminal to connect was discovered. Therefore, the link connection demand for establishing a communication link is sent out to this address that came to hand (step S103). The 5th wireless terminal 115 as a connected terminal returns a connection-request Acknowledgement to the 6th wireless terminal 116 to this (step S104).

[0046] Based on this, the 6th wireless terminal 116 sends out the demand of a transfer rate, in order to carry out the negotiation of the full speed of a transfer rate between this 5th wireless terminal 115 next (step S105). At this time, the maximum of a transfer rate which can respond by the 6th wireless terminal 116 side to the 5th wireless terminal 115 is notified. On the other hand, the 5th wireless terminal 115 carries out answerback of a purport which can respond to the maximum of the notified transfer rate (step S106:Y). When it cannot respond to this rate, the maximum transfer rate which can respond by the 5th (N) terminal [wireless] 115 side will be notified (step S107).

[0047] When the 5th wireless terminal 115 has answered that a transfer is possible at the maximum of the transfer rate of the 6th wireless terminal 116 (step S106:Y), the transfer rate negotiation section 31 in the parameter detecting element 21 shown in drawing 2 saves this in the transfer rate preservation section 41 in the detection result preservation section 22 (step S108). On the other hand, when [the 5th wireless terminal 115] it cannot transmit at the transfer rate of the 6th wireless terminal 116, the transfer rate to which self can respond is notified (step S107:Y). Then, the transfer rate preservation section 41 will save this transfer rate in the transfer rate preservation section 41 similarly in this case (step S109).

[0048] Drawing 9 expresses the response corresponding to a demand and this of the transfer rate between two terminals. The 6th wireless terminal 116 sends out the demand of a transfer rate (step S105), and the 5th wireless terminal 115 is performing answerback to this (steps S106 and S107).

[0049] Thus, if the maximum transfer rate to each of a link and each of these links for the 6th wireless terminal 116 to start a communication link is called for, CPU described above in the information processing CPU unit 51 (drawing 3) will perform detection of the bit error to the

terminal (for example, 5th wireless terminal 115) which can stretch a link. Specifically, the predetermined data packet as data for a check for the command of bit error detection and detection will be sent out to the 5th wireless terminal 115 of a link place (R> drawing 7 7 step S110).

[0050] Here, an explanation supplement is carried out about the predetermined data packet as data for a check. This data packet is attached to the bit error rate detection command for detecting a bit error rate, is sent out, and consists of packets of the specific number used as the specific bit array (bit pattern) beforehand defined between local networks. Each wireless terminal 11 which constitutes a local network is held as a packet for collating in ROM which described above the pattern used as the radical which derives the same thing or this same as this data packet altogether, and the formula. Therefore, the error incidence rate in the root which faces to the wireless terminal 11 of the 5th following wireless terminal 115 grade from the 6th wireless terminal 116 is detectable by receiving the sent-out data packet and collating this with the packet for collating with a bit error rate detection command.

[0051] By the way, the bit pattern for computing such a bit error rate is detected by the bit error rate detecting element 32 shown in drawing 2 in the 5th wireless terminal 115. The bit error rate detecting element 32 counts the number of a bit which caused the error for the above mentioned bit pattern of each of the packets of the specific number as compared with the bit pattern of the packet for collating. And the incidence rate of an error is computed by dividing the number of this error searched for by the total number of bits of a data packet.

[0052] The bit pattern of the data packet used for calculation of a bit error is devised so that a bit string may not become a specific list unsuitable to detection. For this reason, random bit string generation machines, such as an M sequence data generation machine, are used, for example. If an M sequence data generation machine is used, a common random bit pattern is generable among these because each wireless terminal 11 prepares the bit pattern used as the polynomial which generates a bit pattern, and the kind (or origin) used by the polynomial. Therefore, it is not necessary to have all the bit patterns for bit error calculation every wireless terminal 11.

[0053] This will be returned to the 6th wireless terminal 116 of a sending out agency if the 5th wireless terminal 115 side computes a bit error rate about a data packet in the example shown above. The 6th wireless terminal 116 is standing by reception of this bit error rate (drawing 7 step S111). And if a bit error rate is received, (Y) and this are matched with the terminal (here 5th wireless terminal 115) of a transmission place, and this is saved in the bit error rate preservation section 42 shown in drawing 2 (step S112).

[0054] Drawing 10 expresses sending out of the bit error rate detection command between two terminals, and the situation of the answerback to this. The 6th wireless terminal 116 sends out a bit error rate detection command (step S110), and the 5th wireless terminal 115 is performing answerback to this (step S111).

[0055] To each of the 5th, 3rd, 7th, and 8th wireless terminals 115, 113, 117, and 118 shown in drawing 8 , processing of such detection of a bit error rate is performed, as arrow heads 2515, 2513, 2517, and 2518 show, and each result is saved in the bit error rate preservation section 42. Moreover, the link condition preservation section 43 saves the link condition of the these [to which the link was set at present] 5th, 3rd, 7th, and 8th wireless terminals 115, 113, 117, and 118.

[0056] Drawing 11 expresses the flow of processing of weighting of the link performed between the terminal which participated in the local network as processing after the processing shown in drawing 6 , and the terminal of the perimeter. For example, the 6th wireless terminal 116 shown in drawing 8 sets up weighting for every link as data required for a communication link or a setup of the root in the case of junction about each terminal of the 5th [which stretched the link / of the circumference], 3rd, 7th, and 8th wireless terminals 115, 113, 117, and 118. The bit pattern rate in the link between the these 5th, 3rd, 7th, and 8th wireless terminals 115, 113, 117, and 118 is used for this setup (step S121).

[0057] While the these 5th, 3rd, 7th, and 8th wireless terminals 115, 113, 117, and 118 also set up a link with that about the 6th wireless terminal 116 as a terminal which newly participated, it

needs to perform weighting of the root at the time of performing routing. In the case of the latter, the 5th, 3rd, 7th, and 8th wireless terminals 115, 113, 117, and 118 can perform weighting, using directly the bit error rate between the 6th wireless terminal 116 which self computed.
[0058] If it is carried out according to an individual whenever calculation is a demand, the computed root weighting value will be used for a setup of the root so that it may explain later. Therefore, the root weighting value does not need to be saved. Depending on a radio communications system, a root weighting value is periodically computed for every link, and these calculation results are stored in the link condition preservation section 43 (step S122).
[0059] If a root weighting value is set to RootW, this is computable by the following (1) formula.
RootW=BER*BWK+1-/TrRate*TWK .... (1)
[0060] Here, BER is a bit error rate and BWK is the weighting multiplier of a bit error rate. Moreover, TrRate is the transfer rate of a packet and TWK is the weighting multiplier of a transfer rate. Moreover, sign * means addition. By this (1) formula, although the weighting multipliers BWK and TWK change by the arithmetic circuit which the wireless terminal 11 possesses, it is effective to consider as the value which can take the operation precision which is extent which cancellation of significant digits does not produce.
[0061] Moreover, in case these weighting multipliers BWK and TWK are set up, it is also effective to decide these values by for what kind of purpose a local network is used. For example, in a local network which thinks the effect on the communication link quality by the bit error rate as important, the weighting multipliers BWK and TWK will be set up so that the term of "BER*BWK" in (1) type may become a bigger value than the term of "1-/TrRate*TWK."
[0062] These weighting multipliers BWK and TWK are saved in the predetermined part in the detection result preservation section 22 shown in drawing 2 , and can also be used, and it may be made to perform the operation which sets up suitably in the case of the root retrieval explained below, and is shown in (1) type.
[0063] Drawing 12 expresses the condition at the time of there being a local network with a root weighting value. Here, the condition after the 6th wireless terminal 116 shown in drawing 8 participates in a local network is expressed. The figures from "1" to "8" described into the circle (O) like drawing 1 show the terminal address of a terminal proper, and the numeric values from "1" to "5" shown in the link 12 between the wireless terminals 11, respectively express the root weighting value.
[0064] Drawing 13 expresses the flow of the processing as which the terminal which starts a communication link determines the root and which is performed for accumulating. It explains as that to which the 1st wireless terminal 111 in drawing 12 starts radio to the 8th wireless terminal 118. For example, it is a case as the 1st wireless terminal 111 explained previously, so that the data about a schedule may be transmitted to the 8th wireless terminal 118. Since the 1st wireless terminal 111 is the side which starts data communication, when there is a demand of communication link initiation (step S131:Y), this 1st wireless terminal 111 will send out a root detection command. As already explained, before the 1st wireless terminal 111 publishes this root detection command, it is performing the negotiation of the transfer rate about each of the adjoining 2nd, 3rd, and 4th wireless terminals 112, 113, and 114, and bit error detection, saved each maximum transfer rate and a bit error rate in the transfer rate preservation section 41 and the bit error rate preservation section 42, and has updated these to the newest value.
[0065] The 1st wireless terminal 111 computes a root weighting value using these transfers rate and a bit error rate about each of the 2nd, 3rd, and 4th wireless terminals 112, 113, and 114 (step S132). Here, a root weighting value shall search the root where a smaller thing is better. As long as CPU which the information processing CPU unit 51 (drawing 3) within the 1st wireless terminal 111 described above always computes a root weighting value periodically and it saves in the predetermined part in the detection result preservation section 22, these contents may only be read.
[0066] The 1st wireless terminal 111 will choose the terminal which publishes a root find command from the 2nd [which adjoins based on this], 3rd, and 4th wireless terminals 112, 113, and 114, if a root weighting value is computed (step S133). In this example, the number of these wireless terminals 11 is narrowed down to two. Therefore, a terminal with the smallest root

weighting value and a terminal small next will be chosen.
[0067] If two terminals corresponding to such conditions are chosen as a root find command issue terminal (step S133), a root find command will be published by these wireless terminals 11 as an agency terminal (step S134). And the 1st wireless terminal 111 which published this command After the root which results in the 8th wireless terminal 118 as a result with which the procedure in which the wireless terminal 11 as an agency terminal sent out a root find command to the following wireless terminal 11 similarly was repeated is determined The retrieval root answerback sent from the wireless terminal 11 which adjoins as a result to which it is answered sequentially from this 8th wireless terminal 118 will be stood by (step S135). Then, in this example, data communication is performed between the 1st wireless terminal 111 and the 8th wireless terminal 118.
[0068] The retrieval routing section 37 shown in drawing 1 will perform selection of the terminal which publishes a root find command by the above explanation. The example shown in drawing 12 explains this. The 3rd wireless terminal 113 this value of whose is "1" has the smallest root weighting value among the 2nd [which sees and adjoins], 3rd, and 4th wireless terminals [terminal / 111 / 1st / wireless] 112, 113, and 114, and then the 4th wireless terminal 114 whose a value is "2" is small. Then, a root find command is published from the 1st wireless terminal 111 to these two wireless terminals 113 and 114.
[0069] If the 3rd wireless terminal 113 is looked at, it is going to publish a root find command to the 1st wireless terminal 111 and the 2nd wireless terminal 112 from the one where a root weighting value is smaller similarly. However, the 1st wireless terminal 111 is a terminal with which the root was already chosen. Therefore, the 1st wireless terminal 111 is excepted from a candidate. Consequently, the 3rd wireless terminal 113 will publish a root find command to the 2nd wireless terminal 112 and the 7th wireless terminal 117. As for the 4th wireless terminal 114, it is going to publish a root find command to the 1st wireless terminal 111 and the 7th wireless terminal 117 from the one where a root weighting value is smaller similarly. However, the 1st wireless terminal 111 is a terminal with which the root was already chosen similarly. Therefore, the 1st wireless terminal 111 is excepted from a candidate. Consequently, the 4th wireless terminal 114 will publish a root find command to the 7th wireless terminal 117 and the 3rd wireless terminal 113. Sequential selection of the terminal which publishes a root find command like the following will be made.
[0070] Drawing 14 generalizes and expresses signs that the root is set up, between the terminal which required the communication link, and a phase hand's terminal. Here, the terminal (the example currently explained above 1st wireless terminal 111) which is going to communicate is made into the end A of the beginning, and suffix A will be used for the sign showing the circuit apparatus etc. Moreover, A uses as the contiguity terminal B the adjoining terminal (the example currently explained above either of the 2nd, 3rd, and 4th wireless terminals 112, 113, and 114) which sends out a root find command, and uses suffix B for the sign showing that circuit apparatus etc. in this end of the beginning. Furthermore, a communicative phase hand's terminal (the example currently explained above 8th wireless terminal 118) is worn, it considers as Terminal C, and suffix C is used for the sign showing the circuit apparatus etc. Moreover, the terminal which wears with the contiguity terminal B and exists between Terminals C will be collectively expressed as a way station D.
[0071] Root find command sending-out section 36of A A sends out root find command 262A to the contiguity terminal B in the end of the beginning. At the contiguity terminal B, the retrieval routing section 37B chooses two root find command issue terminals similarly about the adjoining wireless terminal 11 on the basis of the end of a local. It becomes conditions that it is not the terminal already chosen at this time as explained previously. Root find command sending-out section 36B of the contiguity terminal B creates root find command 262B based on this, and sends it out to a way station D. It wears from the last way station D like the following, and root find command 262D is sent to retrieval routing section 37C of Terminal C.
[0072] It wears and Terminal C receives root find command 262D from every place. And the root which the optimal root was chosen [root] by the technique explained later, and had retrieval root answerback 263C showing the root chosen is sent out to a way station D in the returning

form. A way station D sends this out to the contiguity terminal B. When the contiguity terminal B receives retrieval root answerback 263D, it will set this to retrieval root answerback 263B, and will send it to root find command sending-out section 36of A A in the end of the beginning. Thus, A wears, can know the most suitable root between Terminals C, will wear it along this determined root, and will start the communication link between Terminals C in the end of the beginning. In addition, the root find command sending-out section 36 shall be equipped not only with a transmitting function but with a reception function, respectively.

[0073] Thus, in the radio communications system which used the wireless terminal by this example, it wore, and finally the 8th [as a terminal C] wireless terminal 118 side chose the root, and has answered this to the 1st [as the end A of the beginning] wireless terminal 111 side. In order to make this possible, the root weighting adder unit 35 shown in drawing 2 is used.

[0074] It explains by returning to drawing 14 . The aggregate value of the address of the contiguity terminal B which performs data communication and along which was worn and it has passed in the beginning end of the transmitting origin of not only the address of Terminal C but a data packet for the address of A and root retrieval, and a way station D, and the weighting information on the root along which it has passed is included in root find command 262D which wears and is sent to retrieval routing section 37C of Terminal C. The address data contained in these roots find command 262D have the composition that the address of transmitting-to the beginning origin is arranged and are arranged at the sequence along which the address of a way station D has passed from the contiguity terminal B next, and a transmission place finally wears and the address of Terminal C is arranged. Therefore, the distribution root to which root find command 262D has been sent can be easily distinguished by reading the address of these single strings.

[0075] Drawing 15 expresses the procedure of processing the root find command by which each terminal has been sent to these. Each wireless terminal 11 is standing by reception of a root find command (step S141). Reception of a root find command extracts the address of the terminal (wearing terminal) which performs (Y) and data communication after this (step S142). And if this expresses the end of a local (step S143:Y), since that wireless terminal 11 will wear in this example and will turn into the 8th wireless terminal 118 as a terminal, retrieval root answerback processing in which it explains later will be performed (step S144).

[0076] On the other hand, in the case of this example, the wireless terminal 11 of plurality (this example two) which adjoins in order to wear, and to relay (step S143:N) and this root find command, in not being the 8th wireless terminal 118 as a terminal, either is chosen (step S145). The terminal these-chosen has a small root weighting value. The sent root weighting value is added to the root weighting value of the selected wireless terminal 11. If the wireless terminal 11 of the following path is chosen as mentioned above, when it searches the same root, the check of whether to be the wireless terminal 11 with which the root was already chosen will be performed (step S146). This is consideration in which it is made for the root formed in the process in which the wireless terminal 11 to relay chooses the following wireless terminal 11 further not to form a closed loop. When the terminal which already published the root find command is included, it will be excepted and then the wireless terminal 11 with a small root weighting value will be added.

[0077] The wireless terminal 11 which received the root find command as mentioned above will publish a root find command to the terminal chosen at step S145 (step S147). Since it serves as plurality every wireless terminal 11 which processes drawing 15 , the number of the terminals with which a root find command is published also increases it in principle, so that the wireless terminal 11 with which a root find command is published has many junction paths.

[0078] It wears and drawing 16 expresses the flow of retrieval root answerback processing by the terminal shown at step S144. Although the 8th wireless terminal 118 wears and it is a terminal in this example, each wireless terminal 11 of it corresponding to this equally which constitutes a local network is natural. The wireless terminal 11 collects the root find commands of the same transmitting origin (step S151). And collection of the root find command of these same transmitting origin is continued until the predetermined time amount t passes in consideration of the time amount which spreads a local network, after a transmitting agency

publishes a root find command first (step S152). However, time amount t does not need to take into consideration even arrival of the root find command which passed through the worst (longest) root. It is because it is the main point which chooses the root good originally. Therefore, a total may be closed, when a total is closed by time amount t and the root find command from the same transmitting origin except reaches the number defined beforehand.
[0079] Thus, if a total is terminated by a certain technique, total of a root weighting value will choose the smallest root (step S153). And retrieval root answerback which shows this root is performed to a transmitting agency (step S154). As step S135 of drawing 13 showed, the wireless terminal 11 which starts a communication link will receive this retrieval root answerback, and will start a communication link by the determined root. Thereby in a previous example, the communication link of the 1st wireless terminal 111 and the 8th wireless terminal 118 is attained.
[0080] In addition, although the terminal to relay publishes a root find command to the next destination at step S147 of drawing 15 , the case where that terminal has left the local network at this time can be made into possibility. Especially the processing in such a case does not pose a problem. It is because such the cut root of that to which the root followed one by one with much trouble from the wireless terminal 11 which starts a communication link will go out at this time is not applicable to a communication link from the first, so there are no implications which continue those processings.
[0081] Finally, after a communication link is started, the case where the wireless terminal 11 which exists on the root leaves a local network is explained. What is necessary is just to choose the root which does not go via such a wireless terminal 11, when some wireless terminals 11 leave a local network in the phase of setting up the root before starting a communication link. However, when the wireless terminal 11 on the root secedes to the midst to which the communication link is performed, it is because it is necessary to reconfigurate the root.
[0082] Drawing 17 shows an example to which the terminal in the middle of the root where the communication link is performed leaves a local network. The root for a communication link is set up between the 1st wireless terminal 111 and the 8th wireless terminal 118 also in the example shown in this drawing. When the path is followed in order, they are the 1st wireless terminal 111, the 2nd wireless terminal 112, the 5th wireless terminal 115, the 6th wireless terminal 116, and the 8th wireless terminal 118. If the 5th wireless terminal 115 moves to the location which an electric wave does not reach here or the power source is disconnected by a certain reason, a link will disappear. It becomes impossible thereby, to communicate the 1st wireless terminal 111 and the 8th wireless terminal 118 by the root which was communicating at the beginning.
[0083] If it becomes such a situation, the 2nd wireless terminal 112 and the 6th wireless terminal 116 contiguous to the 5th wireless terminal 115 will be set as "infinity" (infinity) like illustration of the weighting value of the link between these and the 5th wireless terminal 115. And the 2nd wireless terminal 112 sends out the data packet which shows that the selected root is no longer used to the 1st wireless terminal 111 instead of otherwise transmitting the data packet sent from the 1st wireless terminal 111. The root which newly results in the 8th wireless terminal 118 will be searched with the same procedure with having explained the 1st wireless terminal 111 previously based on this.
[0084] Drawing 18 expresses the flow of processing of each terminal by the side of the junction after communication link initiation. It distinguishes whether the wireless terminal 11 has the reception response to a data packet from a contiguity terminal, when a data packet is transmitted to a contiguity terminal (step S161) (step S162). If there is a reception response, a data packet is sent out to (Y) and its wireless terminal 11 (step S163).
[0085] On the other hand, when there is no reception response and the following terminal shows that sending out of the data packet to this is impossible, the weighting value of the link between (step S162:N) and its wireless terminal 11 is changed into "infinity" (step S164). And it distinguishes whether the weighting value of a link in a direction is "infinity" the side (this example 1st wireless terminal 111) which made the communication link start (step S165). If it is "infinity", processing will be ended, without [(Y) and] performing anything (end). This is for wearing the data packet which shows that the root where the 6th wireless terminal 116 side was

chosen to the data packet sent from the 8th wireless terminal 118 in this example is no longer used, and making it not make it send out to the 8th wireless terminal 118 as a terminal. It is because the both sides of the 1st wireless terminal 111 and the 8th wireless terminal 118 will search the root as a result when such a data packet is sent out.

[0086] The data packet which will make the destination the wireless terminal 11 with the next wireless terminal 11 of the side which it saw [side] from the wireless terminal 11 under processing at step S165, and made the communication link start which made (N) and a communication link start if the weighting value of a link is not "infinity" will be sent out (step S166). In addition, also when the wireless terminal 11 intervenes partly on the way, these wireless terminals 11 perform processing shown in drawing 18 , and make that packet spread one after another in a local network, although this data packet will be directly sent to the 1st wireless terminal 111 in this example.

[0087] The modification of invention [0088] Drawing 19 expresses the configuration of the wireless terminal in the modification of this invention. The same sign is given to the same part as drawing 2 of a previous example, and these explanation is omitted suitably. The wireless terminal 71 of this modification is equivalent to each wireless terminals 111-118 of a previous example. The wireless terminal 71 is equipped with the parameter detecting element 72 which detects the various parameters at the time of performing routing between the terminal of data transmitting origin, and the terminal of the arbitration of a data transmission place by the wireless local network as shown in drawing 1 , and the detection result preservation section 73 for saving various detection results. The parameter detecting element 72 has the composition of having added the amount detecting element 74 of delay to each circuit apparatus inside the parameter detecting element 21 shown in drawing 2 . Moreover, the detection result preservation section 73 has the composition of having added the amount preservation section 75 of delay to each circuit apparatus inside [which was shown in drawing 2] the detection result preservation section 22.

[0089] Here, the amount detecting element 74 of delay is a unit to detect the amount of processing delay of each wireless terminal, in case the wireless terminal which exists in each junction point between a phase hand's wireless terminals the transmitting origin of a data packet relays a root find command. The amount of delay which this amount detecting element 74 of delay detected is saved in the amount preservation section 75 of delay in the detection result preservation section 73.

[0090] Drawing 20 shows the case where it is the simple configuration that the root is formed among three wireless terminals as an example. Here, the terminal which is going to communicate is set to end of the beginning 71A, and a communicative phase hand's terminal is worn and it is referred to as terminal 71C. Moreover, the terminal which adjoins 71A in the end of the beginning is set to contiguity terminal (or junction terminal) 71B. The data packet which 71A emitted in the end of the beginning shall wear through contiguity terminal 71B, and shall be transmitted to terminal 71C.

[0091] Suppose that the time delay for n seconds will arise by the time it wears after contiguity terminal 71B receives the data forwarding instruction from end of the beginning 71A, and it transmits a data forwarding instruction similarly to terminal 71C. In such a case, the actual transfer rate RTrRate (bits per second) to the schedule transfer rate TrRate (bits per second) determined by the transfer rate negotiation section 31 (drawing 19) can be expressed with the following (2) types.

[0092]

RTrRate=TrRate/(1+n) (bits per second) .... (2)

[0093] The root weighting value at the time of taking the amount of delay into consideration now is set to RootWD, and a schedule transfer rate is set to TrRateD. Moreover, the amount of delay of contiguity terminal (or junction terminal) 71B is set to TrD, a bit error rate is set to BER, and the weighting multiplier of TWK and a bit error rate is set to BWK for the weighting multiplier of a transfer rate. The weighting value of the root in this case is calculated by the following (3) types.

[0094]

RootWD=BER*BW/(TrRateD/(1+TrD)) *TWK .... (3)
[0095] Therefore, retrieval of the optimal root which considered data transfer delay of contiguity terminal (or junction terminal) 71B is attained by setting up a root weighting value in consideration of the amount of delay.
[0096] In addition, the example and modification which were explained above cannot be restricted to ad hoc, and can be applied like other radio communications systems which use each wireless terminal also as a junction terminal.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the explanatory view having shown the condition that there was a local network applied in the one example of this invention.
[Drawing 2] It is the block diagram which expressed with this example the important section of the circuitry of the wireless terminal which participates in a local network.
[Drawing 3] It is the block diagram having shown the circuitry of the 5th wireless terminal.
[Drawing 4] It is the block diagram having shown the circuitry of an information processing CPU unit shown in drawing 3 .
[Drawing 5] It is the block diagram having shown the circuitry of a memory unit shown in drawing 3 .
[Drawing 6] It is the flow chart which expressed the flow for the first portion in the phase of the beginning of processing in case one of the wireless terminals participates in a local network with this example.
[Drawing 7] It is the flow chart which expressed the flow of a part with this example the second half in the phase of the beginning of processing in case one of the wireless terminals participates in a local network.
[Drawing 8] It is the explanatory view in which the 6th wireless terminal expressed with this example the condition of trying the wireless terminal of the perimeter, and connection.
[Drawing 9] It is the explanatory view which expressed the response corresponding to a demand and this of the transfer rate between two terminals with this example.
[Drawing 10] It is the explanatory view which expressed sending out of the bit error rate detection command between two terminals, and the situation of the answerback to this with this example.
[Drawing 11] It is a flow chart showing the flow of processing of weighting of the link performed between the terminal which participated in the local network as processing after the processing shown in drawing 6 , and the terminal of the perimeter.
[Drawing 12] It is the explanatory view which expressed the condition at the time of there being a local network with this example with the root weighting value.
[Drawing 13] It is the flow chart where the terminal which starts a communication link expressed with this example the flow of the processing which determines the root, and which is performed for accumulating.
[Drawing 14] It is the explanatory view which generalized and expressed with this example signs that the root was set up, between the terminal which required the communication link, and a phase hand's terminal.
[Drawing 15] It is the flow chart which expressed with this example the procedure of processing the root find command by which each terminal has been sent to these.
[Drawing 16] It is the flow chart which wore and expressed the flow of retrieval root answerback processing by the terminal shown at step S144.
[Drawing 17] The terminal in the middle of the root where the communication link is performed is the explanatory view having shown an example which leaves a local network.
[Drawing 18] It is the flow chart which expressed the flow of processing of each terminal by the

side of the junction after communication link initiation with this example.
[Drawing 19] It is a block diagram showing the configuration of the wireless terminal in the modification of this invention.
[Drawing 20] It is the explanatory view having shown the case where it was the simple configuration that the root is formed among three wireless terminals in this modification.
[Description of Notations]
11 71 Wireless terminal
31 Transfer Rate Negotiation Section
32 Bit Error Rate Detecting Element
33 Link Condition Detecting Element
34 Routing Weighting Calculation Section
35 Root Weighting Adder Unit
36 Root Find Command Sending-Out Section
37 Retrieval Routing Section
38 Retrieval Root Answerback Section
39 Routing-Data Transfer Section
51 Information Processing CPU Unit
53 Memory Unit
57 Communications Control Unit
74 The Amount Detecting Element of Delay
75 The Amount Preservation Section of Delay
A, 71A The end of the beginning
B, 71B Contiguity terminal
C, 71C It wears and is a terminal.
D Way station

[Translation done.]

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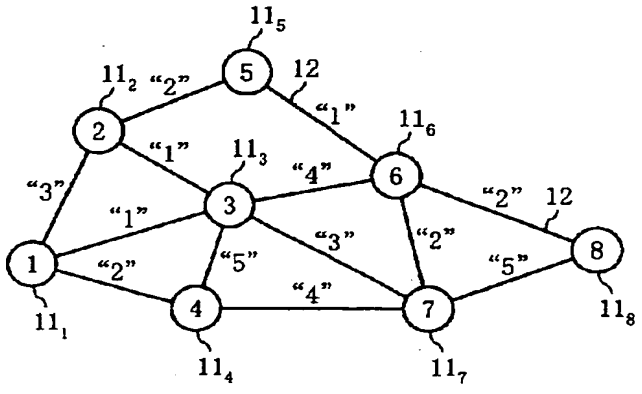
(54)【発明の名称】　無線端末

(57)【要約】
【課題】　アドホックネットワーク等のようなローカルネットワークで、通信に必要な最適のルートを短時間に検索することのできる無線端末を得ること。
【解決手段】　ローカルネットワークを構成する各無線端末１１$_1$～１１$_8$は、互いに隣接する無線端末同士でビットエラーレートと転送速度を設定し、これを基にしてそれぞれの間のリンクについてのルート重み付け値を算出している。ある無線端末が他の無線端末と通信を行うためのルートを設定するには、その無線端末がルート重み付け値を基準にルート検索コマンドを発行しルート重み付け値を隣接端末に伝える。隣接端末は同様にしてルート検索コマンドを伝播させるがこのときルート重み付け値を順次加算していく。通信相手の無線端末は加算後のルート重み付け値から最適となるルートを決定して出発点側に返答する。



【特許請求の範囲】

【請求項１】　一端を隣接する他の端末に接続された各通信路ごとにこれらの通信路を使用して通信を行う際の選択の基準値としての重み付け値を設定する重み付け値設定手段と、

他の端末から所定の端末を通信の相手先とした通信のルートを設定するためのルート検索要求が、それまで経由した通信路の前記重み付け値を付加した形で到来したとき、自端末を起点としたこれに接続される各通信路の重み付け値を参考にしてこれらの通信路のうちから選択した所定の通信路にその通信路の重み付け値を追加した形で送出するルート検索要求中継手段と、

自端末を通信の相手先としたルート検索要求が到来したときには、付加されたそれまで経由した通信路の前記重み付け値を基にして最適のルートを決定するルート決定手段と、

このルート決定手段によって決定されたルートをルート検索要求の送出元に通知するルート検索結果通知手段とを具備することを特徴とする無線端末。

【請求項２】　一端を隣接する他の端末に接続された各通信路のビットエラーレートを測定するビットエラーレート測定手段と、

一端を隣接する他の端末に接続された前記各通信路ごとにそれらの通信路を使用したデータの転送速度を設定する転送速度設定手段と、

これらビットエラーレート測定手段および転送速度設定手段の測定および設定内容に基づいてそれぞれの通信路を使用して相手先の端末との間で行われる通信のルートを設定するための基準値としての重み付け値を設定する重み付け値設定手段と、

所定の相手先との間での通信路の経由の仕方としてのルートを選択した後に通信を開始するとき自端末を起点としたこれに接続される各通信路に対してそれらの重み付け値を付加したルート検索要求を送出するルート検索要求送出手段と、

前記ルート検索要求が、それまで経由した通信路の前記重み付け値を付加した形で到来したとき、自端末を起点としたこれに接続される各通信路の重み付け値を参考にしてこれらの通信路のうちから選択した所定の通信路にその通信路の重み付け値を追加した形で送出するルート検索要求中継手段と、

自端末を通信の相手先としたルート検索要求が到来したときには、付加されたそれまで経由した通信路の前記重み付け値を基にして最適のルートを決定するルート決定手段と、

このルート決定手段によって決定されたルートをルート検索要求の送出元に通知するルート検索結果通知手段と、

ルート検索要求の送出元に対してこのルート検索結果通知手段による通知が到来したとき、これに示されたルートに従って前記通信の相手先に対して通信を開始する通信開始手段とを具備することを特徴とする無線端末。

【請求項３】　一端を隣接する他の端末に接続された各通信路ごとにこれらの通信路を使用して通信を行う際の選択の基準値としての重み付け値を設定する重み付け値設定手段と、

所定の相手先との間での通信路の経由の仕方としてのルートを選択した後に通信を開始するとき自端末を起点としたこれに接続される各通信路に対してそれらの重み付け値を付加したルート検索要求を送出するルート検索要求送出手段と、

前記ルート検索要求が、それまで経由した通信路の前記重み付け値を付加した形で到来したとき、自端末を起点としたこれに接続される各通信路の重み付け値を参考にしてこれらの通信路のうちから選択した所定の通信路にその通信路の重み付け値を追加した形で送出するルート検索要求中継手段と、

自端末を通信の相手先としたルート検索要求が到来したときには、付加されたそれまで経由した通信路の前記重み付け値を基にして最適のルートを決定するルート決定手段と、

このルート決定手段によって決定されたルートをルート検索要求の送出元に通知するルート検索結果通知手段と、

ルート検索要求の送出元に対してこのルート検索結果通知手段による通知が到来したとき、これに示されたルートに従って前記通信の相手先に対して通信を開始する通信開始手段と、

前記ルート検索要求の送出元がルート決定後に送出するデータをこのルートに従って次の通信路に送出するデータ中継手段と、

このデータ中継手段がデータを送出する通信路が使用できなくなったとき前記ルート決定手段の決定したルートの残りを使用して通信を開始した端末にこれを通知する通信不可時通知手段とを具備することを特徴とする無線端末。

【請求項４】　ルート検索要求に付加される重み付け値は、ルート検索要求の送出元から経由した各通信路の重み付け値の加算値であり、前記ルート決定手段はこの加算値の大きさを基にして最適のルートを決定することを特徴とする請求項１～請求項３いずれかに記載の無線端末。

【請求項５】　前記ルート検索要求中継手段は、前記ルート検索要求と共に送られてきたルートを参照してすでに選択されている通信路を使用しない通信路を選択して中継を行うことを特徴とする請求項１～請求項３いずれかに記載の無線端末。

【請求項６】　前記ルート決定手段は、前記重み付け値と共に、前記ルート検索要求が各ルートを経て受信されるまでの所要時間を用いて最適のルートを決定すること

を特徴とする請求項１～請求項３いずれかに記載の無線端末。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は無線端末に係わり、特にローカルネットワークで通信を行う相手先の端末との間でルートを設定することのできる無線端末に関する。

【０００２】

【従来の技術】携帯端末等の無線端末が広範囲に普及しており、これと共にこれらの無線端末同士のローカルな通信にも注目が集まっている。このようなローカルネットワークの代表的なものがアドホック（ad hoc）ネットワークである。アドホックネットワークとは必要に応じて一時的に作成されるローカルなネットワークであり、ネットワークを構成する無線端末は事前に互いの存在を知らない。また、これらのネットワークを集中的に管理するサーバが存在していない。各無線端末は通信のための特別の設定を必要とせず、自律的に周囲の無線端末を認識してネットワークを構築し、情報の交換や共有を行うことができる。このため、ネットワーク上に存在した無線端末が不意に退出するという可能性もあり、このような変化に対して適応できるような仕組みが求められている。

【０００３】このようなローカルネットワークを形成する際には、ある無線端末から他の無線端末にどのような無線端末を経由してデータを転送するかが問題となる。一般にコンピュータ間でデータの送受信を行う場合には、ＯＳＩ（Open System Interconnection：開放型システム間相互接続）におけるネットワーク層で、任意のＩＰアドレスから宛先のＩＰ（Internet Protocol）アドレスまで、ＩＰデータをルーチングプロトコルを利用して転送するようになっている。この際に使用する経路選択のためのルーチングプロトコルとしては、距離を選択の条件とする距離ベクトルルーチングを採用する第１の手法と、リンク状態を選択の条件とするリンク状態ベクトルルーチングを採用する第２の手法が存在している。

【０００４】このうちの第１の手法としての距離ベクトルルーチングでは、ＩＰデータグラムの配送ルートを決定する要素として、ゲートウェイホップのカウント数としてのポップ数を使用し、距離ベクトルを算出することにしている。そして距離ベクトルが短い経路を選択することでルートを決定している。ここでポップ数は、あるＬＡＮ（ローカルエリアネットワーク）に接続された始点から他のＬＡＮに接続された宛先端末までＩＰデータグラムが到達するまでに出会うゲートウェイの数を意味する。

【０００５】第２の手法としてのリンク状態ベクトルを用いたルーチングでは、近接するゲートウェイ間でのリンクが使用可能であるかどうかを示す情報をマッピングし、ネットワーク最短経路探索のアルゴリズムとしてのＤｉｊｋｓｔｒａ（ダイクストラ）アルゴリズムを適用するようにしている。この場合には、１つの始点からすべての終了点に対する最短距離を計算するようにしている。

【０００６】一方、ルーチングに関する技術あるいは手法はこれ以外にも各種提案されている。たとえば特開２０００－４９８５２号公報で提案された第３の手法では、第１の手法としての距離ベクトルルーチングを応用して、探索用のパケット信号の生存期間が終了したときに発生するエラーパケットを受信するたびにホップ数を増加させるようにしている。すなわち、この提案では距離ベクトルを増加させることで、選択する経路の優先順位を変化させている。

【０００７】また、第４の手法として特開２０００－３４１１９９号公報で提案されたようなものも存在している。この第４の手法では、あらかじめ優先順位の付けられた複数の通信経路情報を用いて通信経路を選択し、ネットワークシステムを構築するようにしている。そして、いずれかの通信経路にエラーが発生した場合には、このエラー情報を付加したデータを送信元に戻すようにしている。送信元ではエラー情報を受け取ると、自分が有する経路情報のうちの次に優先順位の高い通信経路に切り替えることで、通信能率を低下させないようにしている。

【０００８】更に、特開２０００－４４６９号公報で提案されたような第５の手法も存在する。この第５の手法は、センタ局と複数の中継ノードおよび複数の無線端末からなる無線通信システムに適用されるものである。この手法では、センタ局が調整要求信号を出力し、中継ノードを介して無線端末がこれを受信する。無線端末は受信電界強度とビットエラーレート等の品質情報を折り返し無線波で送信する。この無線端末の無線波を受信した前記した複数の中継ノードでは、無線波の受信品質情報をこれに追加してセンタ局に送信するようになっている。

【０００９】

【発明が解決しようとする課題】ところで、無線を使用した通信路は、有線による通信路と比較するとネットワークの状況が変化しやすい。たとえば電界強度が時間と共に常に変化するだけでなく、フェージングといった現象も生じる。ここでフェージングとは、電波が建物や樹木等によって反射や回折、散乱を起こすことによって互いに干渉し、その強さが変化する搬送周波数の変動現象である。これらの状況変化を原因として、送信元から受信先に対してデータの送受信エラーが発生する場合がある。送受信エラーの程度はビットエラーレートとして現われる。ビットエラーレートがある程度以上高ければ、通信が不可能になり、通信リンクが切断されるという事

故が発生する。このように無線通信における通信品質は、通信の転送レートも重要であるが、ビットエラーレートによる品質判定も重要になる。

【００１０】このため、以上説明したような各種の提案は、アドホックネットワーク等のローカルネットワークにそのまま適用しようとしても、その適用が困難であった。これを次に説明する。

【００１１】まず、第１の手法について見てみる。静的なネットワークに対してベクトル距離の算出を行う場合に限定すると、この手法は特に問題が生じない。全ての終端について経路テーブルを作成することが比較的簡単だからである。ところが既に説明したアドホックネットワークのようなローカルネットワークの場合には、第１の手法が適さない。ローカルネットワークでは、すでに説明したようにデータの中継を行っていた無線端末が入れ替わるたびに複数の経路検索をやり直す必要があり、しかも経路検索自体に時間を要してしまうために全ての終端について経路テーブルを作成することは現実的でないからである。

【００１２】第２の手法としてのリンク状態ベクトルを用いたルーチングは、第１の手法における距離ベクトルによるルーチング処理の欠点をカバーしたものである。すなわち、リンク状態ベクトルによる経路検索は、隣接するゲートウェイと通信が可能であるかどうかを判定し、これによってルートマップを作成して、それぞれのルートに対して最短距離を計算する。しかしながらこの第２の手法を用いて、専用のゲートウェイを持たないアドホックネットワーク等の無線によるローカルネットワークを構成すると、最適な経路を検索することが困難となる。ネットワークの品質が比較的短い時間で変化する無線通信によるネットワークでは、リンク情報だけでは最適な経路を検索することができないからである。

【００１３】一方、第３の手法では距離ベクトルの応用形としてエラーパケットを受信するたびにホップ数を増加させるようにしている。このようにホップ数を増加させることで選択される経路の優先順位を下げ、最適なルートを選択することは通常のネットワークでは有効である。しかしながら、たとえばモバイル環境下で比較的短い時間にネットワークの品質が変化していくような性格のローカルネットワークでは、時間の経過と共にホップ数を増加させ優先順位を下げるという手法だけでは最適な経路を選択することができない。

【００１４】次に第４の手法について考察する。この第４の手法では、エラーが発生したときに次の優先順位の通信経路に切り替えることで通信状況に対応させている。しかしながら、次の優先順位として選択されるものは予め保存されている優先順位に関する情報である。したがって、前記したようにネットワークの品質が比較的短い時間で変化するような場合には、保存された情報を基にして次の順位であると判別されたものが必ずしもその時点における最適の経路を示すものとは限らない。

【００１５】最後に第５の手法について考察する。第５の手法では、電界強度とビットエラーを用いてルーチングを行い、任意の端末に対して中継局との通信を行う際に通信品質のよい通信局を選択できるようにしている。しかしながら、アドホックネットワークのように無線端末が同時に中継局としての役割を果たすような場合にこの技術を適用しようとすると、中継局と無線端末の１対複数の通信形態とは異なり複数対複数の通信となる。したがって、この第５の手法を用いてルートの検索を行うことはできない。

【００１６】そこで本発明の目的は、アドホックネットワーク等のようなローカルネットワークで、通信に必要な最適のルートを短時間に検索することのできる無線端末を提供することにある。

【００１７】

【課題を解決するための手段】請求項１記載の発明では、（イ）一端を隣接する他の端末に接続された各通信路ごとにこれらの通信路を使用して通信を行う際の選択の基準値としての重み付け値を設定する重み付け値設定手段と、（ロ）他の端末から所定の端末を通信の相手先とした通信のルートを設定するためのルート検索要求が、それまで経由した通信路の重み付け値を付加した形で到来したとき、自端末を起点としたこれに接続される各通信路の重み付け値を参考にしてこれらの通信路のうちから選択した所定の通信路にその通信路の重み付け値を追加した形で送出するルート検索要求中継手段と、（ハ）自端末を通信の相手先としたルート検索要求が到来したときには、付加されたそれまで経由した通信路の重み付け値を基にして最適のルートを決定するルート決定手段と、（ニ）このルート決定手段によって決定されたルートをルート検索要求の送出元に通知するルート検索結果通知手段とを無線端末に具備させる。

【００１８】すなわち請求項１記載の発明では、無線端末が一端を隣接する他の端末に接続された各通信路ごとにこれらの通信路を使用して通信を行う際の選択の基準値としての重み付け値を設定しておく。そして、他の端末から所定の端末を通信の相手先とした通信のルートを設定するためのルート検索要求が到来したときには、重み付け値を参考にして自端末に接続する通信路のうちの幾つかを選択すると共に、ルート検索要求に付加されて送られてきた今までの通信路の重み付け値に今回の通信路の重み付け値を追加した形でこれら選択した通信路にルート検索要求を送出する。このようにしてルート検索要求が送られていくと、遂にはそのルート検索要求が通信の相手先に送られることになる。通信の相手先ではルート検索要求が到来したときには、付加されたそれまで経由した通信路の重み付け値を基にして最適のルートを決定するようにしている。そして、ルート検索結果通知手段でこのルートを通信を開始する側に知らせるように

している。このように請求項１記載の発明では、ルート検索要求が通信の相手先に送られた時点でルートを決定することができるので、ルートの迅速な検索が可能になる。また、通信を開始する側ではルートの検索処理が簡単となる。

【００１９】請求項２記載の発明では、（イ）一端を隣接する他の端末に接続された各通信路のビットエラーレートを測定するビットエラーレート測定手段と、（ロ）一端を隣接する他の端末に接続された前記した各通信路ごとにそれらの通信路を使用したデータの転送速度を設定する転送速度設定手段と、（ハ）これらビットエラーレート測定手段および転送速度設定手段の測定および設定内容に基づいてそれぞれの通信路を使用して相手先の端末との間で行われる通信のルートを設定するための基準値としての重み付け値を設定する重み付け値設定手段と、（ニ）所定の相手先との間での通信路の経由の仕方としてのルートを選択した後に通信を開始するとき自端末を起点としたこれに接続される各通信路に対してそれらの重み付け値を付加したルート検索要求を送出するルート検索要求送出手段と、（ホ）ルート検索要求が、それまで経由した通信路の重み付け値を付加した形で到来したとき、自端末を起点としたこれに接続される各通信路の重み付け値を参考にしてこれらの通信路のうちから選択した所定の通信路にその通信路の重み付け値を追加した形で送出するルート検索要求中継手段と、（ヘ）自端末を通信の相手先としたルート検索要求が到来したときには、付加されたそれまで経由した通信路の重み付け値を基にして最適のルートを決定するルート決定手段と、（ト）このルート決定手段によって決定されたルートをルート検索要求の送出元に通知するルート検索結果通知手段と、（チ）ルート検索要求の送出元に対してこのルート検索結果通知手段による通知が到来したとき、これに示されたルートに従って通信の相手先に対して通信を開始する通信開始手段とを無線端末に具備させる。

【００２０】すなわち請求項２記載の発明では、無線端末が一端を隣接する他の端末に接続された各通信路ごとにこれらの通信路を使用して通信を行う際の選択の基準値としての重み付け値を設定する。重み付け値の設定には、ビットエラーレート測定手段による自端末と一端を接続された各通信路のビットエラーレートの測定結果と、転送速度設定手段による自端末と一端を接続された各通信路ごとにそれらの通信路を使用したデータの転送速度の設定結果が使用される。データの転送速度は通信路を介して対向する端末との間のネゴシエーションで決められてもよい。請求項２記載の発明では、ルート検索要求送出手段を備えている。ルート検索要求送出手段は、無線端末が所定の相手先との間での通信路の経由の仕方としてのルートを選択した後に通信を開始するときに自端末を起点としたこれに接続される各通信路に対してそれらの重み付け値を付加したルート検索要求を送出する手段である。ルート検索要求は通信路を経由して通信の相手先に送られるが、そのとき中継を行う端末は自端末を起点とした通信路の選択についてこれらの重み付け値を参考にすると共に、ルート検索要求を通信路に送り出すときにその通信路についての重み付け値を追加する。通信の相手先はルート検索要求が送られてきたときには今までの各通信路の重み付け値を基にして最適のルートを決定することになる。ルート検索結果通知手段は、このルート決定手段によって決定されたルートをルート検索要求の送出元に通知することになる。これを基に、通信開始手段はその通知されたルートに従って通信の相手先に対して通信を開始することになる。このように請求項２記載の発明では、ルート検索要求が通信の相手先に送られた時点でルートを決定することができるので、ルートの迅速な検索が可能になる。また、通信を開始する側ではルートの検索処理が簡単となる。更に、ビットエラーレートとデータの転送速度を用いて重み付け値を設定しているので、通信速度とデータの信頼性の双方から適正なルートを選択することができる。

【００２１】請求項３記載の発明では、（イ）一端を隣接する他の端末に接続された各通信路ごとにこれらの通信路を使用して通信を行う際の選択の基準値としての重み付け値を設定する重み付け値設定手段と、（ロ）所定の相手先との間での通信路の経由の仕方としてのルートを選択した後に通信を開始するとき自端末を起点としたこれに接続される各通信路に対してそれらの重み付け値を付加したルート検索要求を送出するルート検索要求送出手段と、（ハ）ルート検索要求が、それまで経由した通信路の重み付け値を付加した形で到来したとき、自端末を起点としたこれに接続される各通信路の重み付け値を参考にしてこれらの通信路のうちから選択した所定の通信路にその通信路の重み付け値を追加した形で送出するルート検索要求中継手段と、（ニ）自端末を通信の相手先としたルート検索要求が到来したときには、付加されたそれまで経由した通信路の重み付け値を基にして最適のルートを決定するルート決定手段と、（ホ）このルート決定手段によって決定されたルートをルート検索要求の送出元に通知するルート検索結果通知手段と、（ヘ）ルート検索要求の送出元に対してこのルート検索結果通知手段による通知が到来したとき、これに示されたルートに従って通信の相手先に対して通信を開始する通信開始手段と、（ト）ルート検索要求の送出元がルート決定後に送出するデータをこのルートに従って次の通信路に送出するデータ中継手段と、（チ）このデータ中継手段がデータを送出する通信路が使用できなくなったときルート決定手段の決定したルートの残りを使用して通信を開始した端末にこれを通知する通信不可時通知手段とを無線端末に具備させる。

【００２２】すなわち請求項３記載の発明では、無線端末が一端を隣接する他の端末に接続された各通信路ごと

にこれらの通信路を使用して通信を行う際の選択の基準値としての重み付け値を設定しておく。そして、他の端末から所定の端末を通信の相手先とした通信のルートを設定するためのルート検索要求が到来したときには、重み付け値を参考にして自端末に接続される通信路のうちの幾つかを選択すると共に、ルート検索要求に付加されて送られてきた今までの通信路の重み付け値に今回の通信路の重み付け値を追加した形でこれら選択した通信路にルート検索要求を送出する。このようにしてルート検索要求が送られていくと、遂にはそのルート検索要求が通信の相手先に送られることになる。通信の相手先ではルート検索要求が到来したときには、付加されたそれまで経由した通信路の重み付け値を基にして最適のルートを決定するようにしている。そして、ルート検索結果通知手段でこのルートを通信を開始する側に知らせ通信開始手段で通信の開始を可能にしている。ただし、通信が開始されてもルートの一部となっている端末が移動してしまって中継ができなくなる等の理由でデータ中継手段がデータを送出する通信路が使用できなくなる場合がある。このようなときには該当する端末の存在しない側のルートの部分を使用して、通信不可時通知手段が通信を開始した端末にこれを通知することで、必要に応じてルートの再設定が可能になる。この場合にも通信を再開する側の端末の負担が少なく、かつ迅速な対応が可能である。

【００２３】請求項４記載の発明では、請求項１～請求項３いずれかに記載の無線端末で、ルート検索要求に付加される重み付け値は、ルート検索要求の送出元から経由した各通信路の重み付け値の加算値であり、ルート決定手段はこの加算値の大きさを基にして最適のルートを決定することを特徴としている。

【００２４】すなわち請求項４記載の発明では、ルート検索要求に付加される重み付け値は、ルート検索要求の送出元から経由した各通信路の重み付け値の加算値であるので、それぞれの値を個別に付加して送出する場合よりも送出するパケット等のデータ長を短くすることができる。また、通信の相手先ではこの加算値の一番小さいものあるいは一番大きいものから最適なルートを簡単に判別することができる。なお、各通信路の重み付け値がそれぞれ１以上であれば、加算の代わりに積算を行うことも可能である。

【００２５】請求項５記載の発明では、請求項１～請求項３いずれかに記載の無線端末で、ルート検索要求中継手段は、ルート検索要求と共に送られてきたルートを参照してすでに選択されている通信路以外の通信路を選択して中継を行うことを特徴としている。

【００２６】すなわち請求項５記載の発明では、通信路を次々に選択してルートを設定していくときにすでに選択した通信路を再度選択しないようにすることで、通信の相手先に到達する手前で閉ループを形成するような経路の選択を防止している。

【００２７】請求項６記載の発明では、請求項１～請求項３いずれかに記載の無線端末で、ルート決定手段は、重み付け値と共に、ルート検索要求が各ルートを経て受信されるまでの所要時間を用いて最適のルートを決定することを特徴としている。

【００２８】すなわち請求項６記載の発明では、実際にルート検索要求等の通信に掛かる時間を考慮することで、現実的なルート選択を可能にしている。

【００２９】

【発明の実施の形態】

【００３０】

【実施例】以下実施例につき本発明を詳細に説明する。

【００３１】図１は本発明の一実施例で適用されるローカルネットワークを示したものである。この図で示すように複数の無線端末１１$_1$～１１$_8$が比較的狭い領域に存在しているものとする。それぞれの無線端末１１$_1$～１１$_8$を示す円（○）内に記した“１”から“８”までの数字はこれらの端末固有の端末アドレスを示しているものとする。この図では、第５の無線端末１１$_5$が他の場所から移動してきて、このローカルネットワークに参加した状態を示している。各無線端末１１$_1$～１１$_8$を結ぶ直線は相互のリンク１２を表わしている。この例で第５の無線端末１１$_5$がネットワークに参加すると、このネットワーク内の他の無線端末１１とデータの通信を行うためのリンク１２が張られることになる。反対に、たとえば第８の無線端末１１$_8$がネットワークから離脱すると、この時点でそのリンク１２が解除される。したがって、解除されたリンク１２を利用して通信を行っていた無線端末１１は他のリンク１２を使用する必要が生じることになる。

【００３２】図２は、このローカルネットワークに参加する無線端末の回路構成を機能的に表わしたものである。ここでは第５の無線端末１１$_5$の回路構成を示したが、第１～第４の無線端末１１$_1$～１１$_4$および第６～第８の無線端末１１$_6$～１１$_8$の回路の機能的な構成も基本的にこれと同一である。

【００３３】第５の無線端末１１$_5$は、図１に示したような無線ローカルネットワークでデータ送信元の端末とデータ送信先の任意の端末間のルーチングを行う際の各種パラメータを検出するパラメータ検出部２１と、各種検出結果を保存するための検出結果保存部２２とを備えている。パラメータ検出部２１は、パケットの転送を行う端末との転送速度をネゴシエーションする転送速度ネゴシエーション部３１と、この端末との通信に際してのビットエラーレートを検出するビットエラーレート検出部３２と、隣接する各端末との間のリンク（接続）の有無を確認するためのリンク状態検出部３３と、検出されたビットレートと転送速度でルーチングを行うのに際しての重み付けを算出するルーチング重み付け算出部３４

と、ルーチングを行う際に重み付けの結果を順次加算していくルート重み付け加算部３５と、通信を行う際にルート検索を行うためのルート検索コマンドを送出するルート検索コマンド送出部３６と、検索された最適ルートを選択する検索ルート選択部３７と、検索コマンドを発行した端末に対してこの最適ルートを戻すための返答を行う検索ルート返答部３８、および選択されたルートを通って、中間に位置する端末が送信元のデータを宛先端末に転送するためのルーチングデータを転送するルーチングデータ転送部３９を備えている。

【００３４】一方、検出結果保存部２２は、パラメータ検出部２１における転送速度ネゴシエーション部３１でのネゴシエーションの結果としての転送速度を保存する転送速度保存部４１と、ビットエラーレート検出部３２の検出したビットエラーレートを保存するビットエラーレート保存部４２と、リンク状態検出部３３の検出した現在のリンク状態を保存するリンク状態保存部４３と、第１～第４の無線端末１１_1～１１_4および第６～第８の無線端末１１_6～１１_8と重ならない第５の無線端末１１_5独自の端末アドレスを自己のアドレスとして保存する端末アドレス保存部４４と、検索の結果としての最適ルートを保存する検索ルート保存部４５とを備えている。

【００３５】図３は、このような機能構成を備えた第５の無線端末の回路構成の概要を示したものである。また、図４および図５はこの第５の無線端末の回路の要部を更に具体的に表わしたものである。第１～第４の無線端末１１_1～１１_4および第６～第８の無線端末１１_6～１１_8の回路構成もこれらの図と基本的に同一であるので、これらについての説明は省略する。

【００３６】図３に示す通り、第５の無線端末１１_5は各種制御を行うための情報処理ＣＰＵ（中央処理装置）ユニット５１を備えている。情報処理ＣＰＵユニット５１は、図４に示すようにＣＰＵ（中央処理装置）５１Ａと、このＣＰＵ５１Ａに内部バス５１Ｂによって接続されたタイマ５１Ｃ、割込コントローラ５１Ｄおよびバスコントローラ５１Ｅによって構成されている。ここで、割込コントローラ５１Ｄは割込制御線５１Ｆを接続しており、ＣＰＵ５１Ａに対する割り込みを受け付けるようになっている。タイマ５１Ｃは計時用のハードウェアであるが、この代わりにクロックをカウントする制御プログラムを用いてソフトウェアで構成することもできる。バスコントローラ５１Ｅは図３に示した情報処理ＣＰＵユニット５１と他の回路装置を接続するためのメインバス５２を接続している。

【００３７】図３に戻って説明を続ける。情報処理ＣＰＵユニット５１はクロック信号の供給を受ける第１の発振器５０を接続している。情報処理ＣＰＵユニット５１はメインバス５２を介して端末内の各部と接続されている。このうちメモリユニット５３は、図５に示すようにＲＯＭ５３ＡとＲＡＭ５３Ｂで構成されている。ＲＯＭ５３Ａは図４に示したＣＰＵ５１Ａが実行する制御プログラムを格納すると共に、その他に必要な固定的なデータを格納したリード・オンリ・メモリである。ＲＡＭ５３ＢはＣＰＵ５１Ａがこの制御プログラムに基づいて各種演算処理を行ったりルートの検索等の処理を行う上での演算の途中経過や処理結果等の一時的なデータを保存するためのもので、ランダム・アクセス・メモリによって構成されている。

【００３８】図３におけるＩ／Ｏ（入出力）制御ユニット５４はキー入力部５５を接続しており、これとメインバスとのインタフェース変換を行うようになっている。キー入力部５５はユーザが端末の探索処理を起動するといったユーザインタフェースとなる部分である。

【００３９】ディスプレイユニット５６は各種処理結果等の視覚的なデータを表示する装置である。通信制御ユニット５７は他の無線端末との通信の制御を行うもので、本実施例ではアンテナ５８を接続したＲＦ（Radio Frequency：無線周波数）ユニット５９を接続している。ここでＲＦユニット５９は、アナログ無線信号の増幅および検波を行う回路であり、アンテナ５８はアナログ無線信号を送受信するようになっている。ＲＦユニット５９には第２の発振器６１が、また通信制御ユニット５７には第３の発振器６２がそれぞれ接続されており、所定の発信出力が供給されるようになっている。情報処理ＣＰＵユニット５１は図４で示した割込制御線５１Ｆと接続されており、必要な割込制御を受けるようになっている。

【００４０】図２で示した転送速度保存部４１等の検出結果保存部２２内の各回路は、メモリユニット５３内のＲＡＭ５３Ｂの各領域を用いて構成されている。また、パラメータ検出部２１は情報処理ＣＰＵユニット５１やＲＦユニット５９等によって構成されている。

【００４１】図６および図７は、以上説明したような構成の無線端末の１つがローカルネットワークに参加する場合の処理の最初の段階における流れを表わしたものである。一例として、第６の無線端末１１_6が第１の無線端末１１_1との間で通信を開始するためにローカルネットワークに参加する場合がある。たとえば第６の無線端末１１_6が第１の無線端末１１_1に対して自己の装置内に格納されているスケジュールに関するデータを送信するようなアプリケーションを起動させるような場合である。もちろん、図１に示したように第６の無線端末１１_6が第５の無線端末１１_5等から構成されるこのローカルネットワークに近づいて、何らかの理由でこれに参加する場合もある。

【００４２】このような場合に第６の無線端末１１_6はその周囲に位置し、かつ他の端末にパケットを中継することのできる端末に対して、端末探索要求を送出して接続を試みることになる。第６の無線端末１１_6が第１の無線端末１１_1との間で通信を試みる場合でも、その時

点でどのようなルートを経て通信してよいかも分からない第１の無線端末１１$1_1$に対して通信を開始させるためには、まず自局に近い端末と接続し、第１の無線端末１１$1_1$と接続される要求をこれらの端末に送出し、これらの端末が第１の無線端末１１$1_1$でない場合には、同様の要求を次々と他の端末に伝播させながら、最終的に第１の無線端末１１$1_1$にその要求を伝達する必要があるからである。

【００４３】第６の無線端末１１$6_6$はまずその周囲に手動または自動で端末探索要求を送出する（図６ステップＳ１０１）。端末探索要求には接続要求端末としての第６の無線端末１１$6_6$の自アドレスが含まれている。手動による探索は、第６の無線端末１１$6_6$の使用者がローカルネットワークを形成しているコミュニティを発見し、そのコミュニティに接続するために意図的に探索を実行する場合である。これに対して自動による探索は、図４に示したタイマ５１Ｃのセットによって第６の無線端末１１$6_6$に一定時間ごとに定期的に探索を行う場合である。

【００４４】図８は、第６の無線端末がその周囲の無線端末と接続を試みる状態を表わしたものである。この例では第６の無線端末１１$6_6$の無線の届く範囲に第５、第３、第７および第８の無線端末１１$5_5$、１１$3_3$、１１$7_7$、１１$8_8$が存在している。したがって、この図８に示した例では、これらの端末から返答が来る可能性がある。説明を簡単にするために第５の無線端末１１$5_5$から返答がある場合を説明する。

【００４５】第５の無線端末１１$5_5$は第６の無線端末１１$6_6$の端末探索要求を受信すると、接続要求端末としてのこの第６の無線端末１１$6_6$に対して接続確認応答として被接続端末の自アドレス、すなわち第５の無線端末１１$5_5$の自アドレスを送出する（ステップＳ１０２）。第６の無線端末１１$6_6$は第５の無線端末１１$5_5$の自アドレスを入手することで、接続したい無線端末が発見されたことになる。したがって、入手したこのアドレスに対して、通信リンクを確立するためのリンク接続要求を送出する（ステップＳ１０３）。被接続端末としての第５の無線端末１１$5_5$はこれに対して接続要求確認応答を第６の無線端末１１$6_6$に返送する（ステップＳ１０４）。

【００４６】これを基に、第６の無線端末１１$6_6$は次にこの第５の無線端末１１$5_5$との間で転送レートの最高速度をネゴシエーションするために転送レートの要求を送出する（ステップＳ１０５）。このとき、第５の無線端末１１$5_5$に対しては第６の無線端末１１$6_6$側で対応することのできる転送レートの最大値を通知する。これに対して第５の無線端末１１$5_5$はその通知した転送レートの最大値に対応できる旨の返答をする（ステップＳ１０６：Ｙ）。この速度に対応できないときには（Ｎ）第５の無線端末１１$5_5$側で対応できる最大転送速度を通知することになる（ステップＳ１０７）。

【００４７】第５の無線端末１１$5_5$が第６の無線端末１１$6_6$の転送レートの最大値で転送が可能と応答してきた場合（ステップＳ１０６：Ｙ）、図２に示したパラメータ検出部２１内の転送速度ネゴシエーション部３１はこれを検出結果保存部２２内の転送速度保存部４１に保存する（ステップＳ１０８）。これに対して第５の無線端末１１$5_5$が第６の無線端末１１$6_6$の転送レートで転送することができないとした場合には、自己の対応できる転送速度が通知されてくる（ステップＳ１０７：Ｙ）。そこでこの場合、転送速度保存部４１はこの転送速度を同様に転送速度保存部４１に保存することになる（ステップＳ１０９）。

【００４８】図９は、２つの端末間での転送レートの要求とこれに対応した応答を表わしたものである。第６の無線端末１１$6_6$が転送レートの要求を送出し（ステップＳ１０５）、第５の無線端末１１$5_5$がこれに対する返答を行っている（ステップＳ１０６、Ｓ１０７）。

【００４９】このようにして第６の無線端末１１$6_6$が通信を開始するためのリンクのそれぞれとこれらの各リンクに対する最大転送速度が求められたら、情報処理ＣＰＵユニット５１（図３）内の前記したＣＰＵはリンクを張ることのできる端末（たとえば第５の無線端末１１$5_5$）に対するビットエラーの検出作業を行う。具体的にはビットエラー検出のコマンドおよび検出のためのチェック用データとしての所定のデータパケットを、リンク先の第５の無線端末１１$5_5$に送出することになる（図７ステップＳ１１０）。

【００５０】ここで、チェック用データとしての所定のデータパケットについて説明補足する。このデータパケットはビットエラーレートを検出するためのビットエラーレート検出コマンドに付属して送出されるもので、予めローカルネットワーク間で定められた特定のビット配列（ビットパターン）となった特定の個数のパケットから構成されている。ローカルネットワークを構成する各無線端末１１はすべてこのデータパケットと同一のものあるいはこれを導出する基となるパターンや計算式を前記したＲＯＭ内に照合用パケットとして保持している。したがって、ビットエラーレート検出コマンドと共に送出されてきたデータパケットを受信してこれを照合用パケットと照合することで、第６の無線端末１１$6_6$から次の第５の無線端末１１$5_5$等の無線端末１１に向かうルートでのエラー発生率を検出することができる。

【００５１】ところで、このようなビットエラーレートを算出するためのビットパターンは、たとえば第５の無線端末１１$5_5$における図２に示したビットエラーレート検出部３２で検出される。ビットエラーレート検出部３２は、前記した特定の個数のパケットの１つ１つのビットパターンを、照合用パケットのビットパターンと比較し、エラーを起こしたビットの個数をカウントする。そして求められたこのエラーの個数をデータパケットの総

ビット数で割ることによってエラーの発生率を算出する。

【００５２】ビットエラーの算出に使用されるデータパケットのビットパターンは、ビット列が検出に不適切な特定の並びにならないように工夫されている。このために、たとえばＭ系列データ生成器等のランダムビット列生成器が使用される。Ｍ系列データ生成器を使用すると、ビットパターンを生成する多項式と、その多項式で使用する種（あるいは元）となるビットパターンをそれぞれの無線端末１１が用意しておくことで、これらの間で共通なランダムのビットパターンを生成することができる。したがって、無線端末１１ごとにビットエラー算出用のビットパターンをすべて持っておく必要はない。

【００５３】上に示した例で第５の無線端末１１_5側がデータパケットについてビットエラーレートを算出したら、送出元の第６の無線端末１１_6にこれを返送する。第６の無線端末１１_6はこのビットエラーレートの受信を待機している（図７ステップＳ１１１）。そしてビットエラーレートが受信されたら（Ｙ）、これを送信先の端末（ここでは第５の無線端末１１_5）と対応付けて、図２に示すビットエラーレート保存部４２にこれを保存する（ステップＳ１１２）。

【００５４】図１０は、２つの端末間でのビットエラーレート検出コマンドの送出とこれに対する返答の様子を表わしたものである。第６の無線端末１１_6がビットエラーレート検出コマンドを送出し（ステップＳ１１０）、第５の無線端末１１_5がこれに対する返答を行っている（ステップＳ１１１）。

【００５５】このようなビットエラーレートの検出の処理は、図８に示す第５、第３、第７および第８の無線端末１１_5、１１_3、１１_7、１１_8のそれぞれに対して、矢印２５１_5、２５１_3、２５１_7、２５１_8で示すように行われ、それぞれの結果がビットエラーレート保存部４２に保存される。また、リンク状態保存部４３はリンクが現時点で設定されたこれら第５、第３、第７および第８の無線端末１１_5、１１_3、１１_7、１１_8のリンク状態を保存する。

【００５６】図１１は、図６に示した処理以降の処理としてローカルネットワークに参加した端末とその周囲の端末との間で行われるリンクの重み付けの処理の流れを表わしたものである。たとえば図８に示した第６の無線端末１１_6は、リンクを張った周辺の第５、第３、第７および第８の無線端末１１_5、１１_3、１１_7、１１_8の各端末について、通信あるいは中継の際のルートの設定に必要なデータとしてリンクごとの重み付けを設定する。この設定にはこれら第５、第３、第７および第８の無線端末１１_5、１１_3、１１_7、１１_8との間のリンクにおけるビットパターンレートが使用される（ステップＳ１２１）。

【００５７】これら第５、第３、第７および第８の無線端末１１_5、１１_3、１１_7、１１_8の方も、新たに参加した端末としての第６の無線端末１１_6についてそれとのリンクを設定すると共にルーチングを行う際のルートの重み付けを行う必要がある。後者の場合には、第５、第３、第７および第８の無線端末１１_5、１１_3、１１_7、１１_8は自己が算出した第６の無線端末１１_6との間のビットエラーレートを直接用いて重み付けを行うことができる。

【００５８】算出が要求の度に個別に行われるものであれば、算出したルート重み付け値は後に説明するようにルートの設定のために使用される。したがって、そのルート重み付け値が保存される必要はない。無線通信システムによってはルート重み付け値の算出をリンクごとに定期的に行ってこれらの算出結果をリンク状態保存部４３に格納する（ステップＳ１２２）。

【００５９】ルート重み付け値をＲｏｏｔＷとすると、これは次の（１）式で算出することができる。

$$RootW = BER * BWK + 1 / TrRate * TWK \cdots\cdots (1)$$

【００６０】ここで、ＢＥＲはビットエラーレートであり、ＢＷＫはビットエラーレートの重み付け係数である。またＴｒＲａｔｅはパケットの転送レートであり、ＴＷＫは転送レートの重み付け係数である。また、符号＊は、積算を意味する。この（１）式で重み付け係数ＢＷＫ、ＴＷＫは、無線端末１１の所持する演算回路によって変わってくるが、桁落ちが生じない程度の演算精度がとれる値とすることが有効である。

【００６１】また、これらの重み付け係数ＢＷＫ、ＴＷＫを設定する際には、ローカルネットワークをどのような目的で使用するかによってこれらの値を決めることも有効である。たとえばビットエラーレートによる通信品質への影響を重視するようなローカルネットワークでは、（１）式中の「ＢＥＲ＊ＢＷＫ」の項が「１／ＴｒＲａｔｅ＊ＴＷＫ」の項よりも大きな値になるように重み付け係数ＢＷＫ、ＴＷＫを設定することになる。

【００６２】これらの重み付け係数ＢＷＫ、ＴＷＫは、図２に示した検出結果保存部２２内の所定の箇所に保存しておいて利用することもできるし、次に説明するルート検索の際に適宜設定して（１）式に示す演算を行うようにしてもよい。

【００６３】図１２は、ローカルネットワークのある時点の状態をルート重み付け値と共に表わしたものである。ここでは、図８に示した第６の無線端末１１_6がローカルネットワークに参加した後の状態を表わしている。図１と同様に円（○）内に記した“１”から“８”までの数字は端末固有の端末アドレスを示しており、無線端末１１間のリンク１２にそれぞれ示した“１”から“５”までの数値はルート重み付け値を表わしている。

【００６４】図１３は、通信を開始する端末がルートを

決定するために行う処理の流れを表わしたものである。図１２における第１の無線端末１１$_1$が第８の無線端末１１$_8$に対して無線通信を開始するものとして説明を行う。たとえば第１の無線端末１１$_1$が先に説明したようにスケジュールに関するデータを第８の無線端末１１$_8$に送信するような場合である。第１の無線端末１１$_1$がデータ通信を開始する側なので、通信開始の要求があると（ステップＳ１３１：Ｙ）、この第１の無線端末１１$_1$がルート検出コマンドを送出することになる。すでに説明したように、第１の無線端末１１$_1$はこのルート検出コマンドを発行する前に、隣接する第２、第３および第４の無線端末１１$_2$、１１$_3$、１１$_4$のそれぞれについての転送速度のネゴシエーションおよびビットエラー検出を行っており、それぞれの最大転送速度およびビットエラーレートを転送速度保存部４１およびビットエラーレート保存部４２に保存し、これらを最新値に更新している。

【００６５】第１の無線端末１１$_1$は、これら転送レートとビットエラーレートを用いて第２、第３および第４の無線端末１１$_2$、１１$_3$、１１$_4$のそれぞれについてルート重み付け値を算出する（ステップＳ１３２）。ここで、ルート重み付け値は小さいものほど良好なルートを検索できるものとする。第１の無線端末１１$_1$内の情報処理ＣＰＵユニット５１（図３）の前記したＣＰＵが常に定期的にルート重み付け値を算出し、検出結果保存部２２内の所定の箇所に保存しているのであれば、この内容を単に読み出すものであってもよい。

【００６６】第１の無線端末１１$_1$は、ルート重み付け値を算出したらこれを基にして隣接する第２、第３および第４の無線端末１１$_2$、１１$_3$、１１$_4$の中からルート検索コマンドを発行する端末を選択する（ステップＳ１３３）。本実施例ではこの無線端末１１の数を２つに絞り込むことにしている。したがって、ルート重み付け値が最も小さな端末と次に小さい端末が選択されることになる。

【００６７】このような条件に合致した２つの端末がルート検索コマンド発行端末として選択されたら（ステップＳ１３３）、仲介端末としてのこれらの無線端末１１にルート検索コマンドが発行される（ステップＳ１３４）。そしてこのコマンドを発行した第１の無線端末１１$_1$は、仲介端末としての無線端末１１が同様にしてルート検索コマンドを次の無線端末１１に送出するという手順が繰り返された結果としての第８の無線端末１１$_8$に至るルートが決定された後に、この第８の無線端末１１$_8$から順に返答される結果としての隣接する無線端末１１から送られてくる検索ルート返答を待機することになる（ステップＳ１３５）。この後、この例では第１の無線端末１１$_1$と第８の無線端末１１$_8$の間でデータ通信が実行される。

【００６８】以上の説明で、ルート検索コマンドを発行する端末の選択は図１に示す検索ルート選択部３７が行うことになる。図１２に示した例でこれを説明する。第１の無線端末１１$_1$から見て隣接する第２、第３および第４の無線端末１１$_2$、１１$_3$、１１$_4$のうちルート重み付け値が最も小さいのは、この値が“１”である第３の無線端末１１$_3$であり、次に小さいのは値が“２”である第４の無線端末１１$_4$である。そこで第１の無線端末１１$_1$からこれら２つの無線端末１１$_3$、１１$_4$に対してルート検索コマンドが発行される。

【００６９】第３の無線端末１１$_3$について見てみると、同様にしてルート重み付け値が小さい方から第１の無線端末１１$_1$と第２の無線端末１１$_2$に対してルート検索コマンドを発行しようとする。しかしながら、第１の無線端末１１$_1$は既にルートの選択された端末である。したがって、第１の無線端末１１$_1$は候補から除外される。この結果、第３の無線端末１１$_3$は第２の無線端末１１$_2$と第７の無線端末１１$_7$に対してルート検索コマンドを発行することになる。第４の無線端末１１$_4$は同様にしてルート重み付け値が小さい方から第１の無線端末１１$_1$と第７の無線端末１１$_7$に対してルート検索コマンドを発行しようとする。しかしながら、同様に第１の無線端末１１$_1$は既にルートの選択された端末である。したがって、第１の無線端末１１$_1$は候補から除外される。この結果、第４の無線端末１１$_4$は第７の無線端末１１$_7$と第３の無線端末１１$_3$に対してルート検索コマンドを発行することになる。以下同様にしてルート検索コマンドを発行する端末が順次選択されていくことになる。

【００７０】図１４は、通信を要求した端末と相手先の端末の間でルートが設定される様子を一般化して表わしたものである。ここでは通信を行おうとしている端末（以上説明している例では第１の無線端末１１$_1$）を発端末Ａとし、その回路装置等を表わす符号に添え字Ａを使用することにする。また、この発端末Ａがルート検索コマンドを送出する隣接した端末（以上説明している例では第２、第３および第４の無線端末１１$_2$、１１$_3$、１１$_4$のいずれか）を隣接端末Ｂとし、その回路装置等を表わす符号に添え字Ｂを使用する。更に、通信の相手先の端末（以上説明している例では第８の無線端末１１$_8$）を着端末Ｃとし、その回路装置等を表わす符号に添え字Ｃを使用する。また、隣接端末Ｂと着端末Ｃの間に存在する端末を一括して中間端末Ｄとして表わすことにする。

【００７１】発端末Ａのルート検索コマンド送出部３６$_A$は、ルート検索コマンド２６２$_A$を隣接端末Ｂに送出する。隣接端末Ｂではその検索ルート選択部３７$_B$が自端末を起点とした隣接する無線端末１１について同様にしてルート検索コマンド発行端末を２つ選択する。このとき、先に説明したように既に選択された端末ではないことが条件となる。隣接端末Ｂのルート検索コマンド送出

部３６$_B$は、これを基にしてルート検索コマンド２６２$_B$を作成して中間端末Ｄに送出する。以下同様にして最後の中間端末Ｄから着端末Ｃの検索ルート選択部３７$_C$にルート検索コマンド２６２$_D$が送られる。

【００７２】着端末Ｃはルート検索コマンド２６２$_D$を各所から受信する。そして、後に説明する手法で最適なルートを選択し、そのルートを表わした検索ルート返答２６３$_C$を選択されたルートを戻る形で中間端末Ｄに送出する。中間端末Ｄはこれを隣接端末Ｂに送出する。隣接端末Ｂは検索ルート返答２６３$_D$を受信すると、これを検索ルート返答２６３$_B$として発端末Ａのルート検索コマンド送出部３６$_A$に送ることになる。このようにして発端末Ａは着端末Ｃとの間の最も適切なルートを知ることができ、この決定されたルートに沿って着端末Ｃとの間の通信を開始することになる。なお、ルート検索コマンド送出部３６は、それぞれ送信機能だけでなく、受信機能も備えているものとする。

【００７３】このように本実施例による無線端末を使用した無線通信システムでは、着端末Ｃとしての第８の無線端末１１$_8$側がルートを最終的に選択してこれを発端末Ａとしての第１の無線端末１１$_1$側に返答している。これを可能とするために図２に示したルート重み付け加算部３５が用いられている。

【００７４】図１４に戻って説明を行う。着端末Ｃの検索ルート選択部３７$_C$に送られてくるルート検索コマンド２６２$_D$には、データ通信を行う着端末Ｃのアドレスだけでなく、データパケットの送信元の発端末Ａのアドレス、ルート検索のために通ってきた隣接端末Ｂや中間端末Ｄのアドレスならびに通ってきたルートの重み付け情報の加算値が含まれている。これらルート検索コマンド２６２$_D$に含まれるアドレスデータは、最初に送信元のアドレスが配置され、次に隣接端末Ｂから中間端末Ｄのアドレスが通ってきた順番に配置され、最後に送信先の着端末Ｃのアドレスが配置されるという構成となっている。したがって、これら一連のアドレスを読み出すことでルート検索コマンド２６２$_D$が送られてきた配信ルートを簡単に判別することができる。

【００７５】図１５は、各端末がこれらに送られてきたルート検索コマンドを処理する手順を表わしたものである。各無線端末１１はルート検索コマンドの受信を待機している（ステップＳ１４１）。ルート検索コマンドを受信すると（Ｙ）、データ通信を行う端末（着端末）のアドレスをこれから抽出する（ステップＳ１４２）。そして、これが自端末を表わすものであれば（ステップＳ１４３：Ｙ）、その無線端末１１がこの例では着端末としての第８の無線端末１１$_8$となるので、後で説明する検索ルート返答処理を行うことになる（ステップＳ１４４）。

【００７６】一方、この例の場合、着端末としての第８の無線端末１１$_8$でもない場合には（ステップＳ１４３：Ｎ）、このルート検索コマンドを中継するために隣接する複数（本実施例では２つ）の無線端末１１を選択する（ステップＳ１４５）。これら選択される端末はルート重み付け値が小さなものである。選択された無線端末１１のルート重み付け値には、送られてきたルート重み付け値が加算される。以上のようにして次の経路の無線端末１１を選択したら、それが同一のルートを検索していくときに既にルートの選択された無線端末１１であるかどうかのチェックが行われる（ステップＳ１４６）。これは、中継する無線端末１１が更に次の無線端末１１を選択する過程で形成されるルートが閉ループを形成しないようにする配慮である。既にルート検索コマンドを発行した端末が含まれていた場合には、それを除外して次にルート重み付け値が小さな無線端末１１が追加されることになる。

【００７７】以上のようにして、ルート検索コマンドを受信した無線端末１１はステップＳ１４５で選択した端末に対してルート検索コマンドを発行することになる（ステップＳ１４７）。ルート検索コマンドの発行される無線端末１１は、図１５の処理を行う無線端末１１ごとに複数となるので、中継経路が多いほどルート検索コマンドが発行される端末の数も原則として増加する。

【００７８】図１６はステップＳ１４４で示した着端末による検索ルート返答処理の流れを表わしたものである。本実施例では第８の無線端末１１$_8$が着端末であるが、ローカルネットワークを構成する各無線端末１１が等しくこれに該当する可能性があることはもちろんである。無線端末１１は同一送信元同士のルート検索コマンドを集める（ステップＳ１５１）。そして、送信元がルート検索コマンドを最初に発行してからローカルネットワークを伝搬してくる時間を考慮して所定の時間ｔが経過するまでこの同一送信元同士のルート検索コマンドの収集を継続する（ステップＳ１５２）。ただし、時間ｔは最悪（最長）なルートを経たルート検索コマンドの到着までを考慮する必要はない。本来良好なルートを選択する主旨だからである。したがって、時間ｔで集計を打ち切る場合以外に、同一送信元からのルート検索コマンドが予め定めた個数に到達した時点で集計を打ち切ってもよい。

【００７９】このように何らかの手法で集計を終了させたら、ルート重み付け値の総和が最も小さいルートを選択する（ステップＳ１５３）。そして、送信元にこのルートを示す検索ルート返答を行う（ステップＳ１５４）。図１３のステップＳ１３５で示したように、通信を開始する無線端末１１はこの検索ルート返答を受信して、決定されたルートで通信を開始することになる。先の例ではこれにより第１の無線端末１１$_1$と第８の無線端末１１$_8$の通信が可能になる。

【００８０】なお、図１５のステップＳ１４７では中継する端末が次の宛先にルート検索コマンドを発行する

が、この時点でその端末がローカルネットワークから脱退している場合が可能性としてあり得る。このような場合の処理は特に問題とならない。なぜなら、通信を開始する無線端末１１からせっかく順次辿ってきたルートがこの時点で切れることになるものの、このような切断されたルートは元々通信に使えないものなので、それらの処理を継続する意味合いがないからである。

【００８１】最後に、通信が開始された後にそのルート上に存在する無線端末１１がローカルネットワークを脱退する場合について説明する。通信を開始する前のルートを設定する段階で無線端末１１の一部がローカルネットワークから脱退する場合には、そのような無線端末１１を経由しないルートを選択すればよい。しかしながら通信が行われている最中にそのルート上の無線端末１１が脱退した場合には、ルートを再構成する必要があるからである。

【００８２】図１７は、通信の行われているルートの途中の端末がローカルネットワークから脱退する一例を示したものである。この図に示した例でも第１の無線端末11_1と第８の無線端末11_8との間で通信のためのルートが設定されている。その経路を順に辿ると、第１の無線端末11_1、第２の無線端末11_2、第５の無線端末11_5、第６の無線端末11_6、第８の無線端末11_8である。ここで第５の無線端末11_5が電波の届かない位置に移動したり、その電源が何らかの理由で切断されると、リンクが消失する。これにより、当初通信していたルートでは第１の無線端末11_1と第８の無線端末11_8が通信できなくなる。

【００８３】このような状況になると、第５の無線端末11_5と隣接している第２の無線端末11_2および第６の無線端末11_6は、これらと第５の無線端末11_5の間のリンクの重み付け値を図示のように“∞”（無限大）に設定する。そして、第２の無線端末11_2は第１の無線端末11_1から送られてきたデータパケットを他に転送する代わりに、選択されていたルートが使用されなくなったことを示すデータパケットを第１の無線端末11_1に送出する。第１の無線端末11_1はこれを基にして、先に説明したと同様の手順で新たに第８の無線端末11_8に至るルートを検索することになる。

【００８４】図１８は、通信開始後の中継側の各端末の処理の流れを表わしたものである。無線端末１１は隣接端末へデータパケットを送信すると（ステップＳ１６１）、隣接端末からデータパケットに対する受信応答があるかどうかを判別する（ステップＳ１６２）。受信応答があれば（Ｙ）、その無線端末１１にデータパケットを送出する（ステップＳ１６３）。

【００８５】一方、次の端末から受信応答がなくこれに対するデータパケットの送出が不可能であることが分かった場合には（ステップＳ１６２：Ｎ）、その無線端末１１との間のリンクの重み付け値を“∞”に変更する（ステップＳ１６４）。そして、通信を開始させた側（この例では第１の無線端末11_1）方向へのリンクの重み付け値が“∞”であるかどうかを判別する（ステップＳ１６５）。“∞”であれば（Ｙ）、何も行わずに処理を終了する（エンド）。これはこの例で第６の無線端末11_6側が第８の無線端末11_8から送られてきたデータパケットに対しては選択されていたルートが使用されなくなったことを示すデータパケットを着端末としての第８の無線端末11_8に送出させないようにするためである。このようなデータパケットを送出させると、結果的に第１の無線端末11_1と第８の無線端末11_8の双方がルートを探索することになるからである。

【００８６】ステップＳ１６５で処理中の無線端末１１から見て通信を開始させた側の次の無線端末１１とのリンクの重み付け値が“∞”でなければ（Ｎ）、通信を開始させた無線端末１１を宛先とするデータパケットを送出することになる（ステップＳ１６６）。なおこの例ではこのデータパケットは第１の無線端末11_1に直接送られることになるが、途中に無線端末１１が幾つか介在する場合にもこれらの無線端末１１は図１８に示した処理を行ってそのパケットをローカルネットワーク中で次々と伝播させていくことになる。

【００８７】発明の変形例

【００８８】図１９は、本発明の変形例における無線端末の構成を表わしたものである。先の実施例の図２と同一部分には同一の符号を付しており、これらの説明を適宜省略する。この変形例の無線端末７１は、先の実施例の各無線端末11_1～11_8に対応するものである。無線端末７１は、図１に示したような無線ローカルネットワークでデータ送信元の端末とデータ送信先の任意の端末間のルーチングを行う際の各種パラメータを検出するパラメータ検出部７２と、各種検出結果を保存するための検出結果保存部７３とを備えている。パラメータ検出部７２は、図２に示したパラメータ検出部２１の内部の各回路装置に遅延量検出部７４を加えた構成となっている。また、検出結果保存部７３は図２に示した検出結果保存部２２の内部の各回路装置に遅延量保存部７５を加えた構成となっている。

【００８９】ここで、遅延量検出部７４は、データパケットの送信元と相手先の無線端末との間の各中継地点に存在する無線端末が、ルート検索コマンドの中継を行う際に各無線端末の処理遅延量を検出するためのユニットである。この遅延量検出部７４の検出した遅延量は、検出結果保存部７３内の遅延量保存部７５に保存される。

【００９０】図２０は、一例として３つの無線端末間でルートが形成される簡易な構成の場合を示したものである。ここでは、通信を行おうとしている端末を発端末７１Ａとし、通信の相手先の端末を着端末７１Ｃとする。また、発端末７１Ａに隣接している端末を隣接端末（あるいは中継端末）７１Ｂとする。発端末７１Ａの発した

データパケットが隣接端末７１Ｂを通して着端末７１Ｃに送信されるものとする。

【００９１】隣接端末７１Ｂが発端末７１Ａからのデータ送出命令を受け取ってから着端末７１Ｃに対してデータ送出命令を同様に送信するまでにｎ秒の遅延時間が生じるとする。このような場合、転送速度ネゴシエーション部３１（図１９）によって決定された予定転送レートＴｒＲａｔｅ（ビット／秒）に対する実際の転送レートＲＴｒＲａｔｅ（ビット／秒）は、次の（２）式で表わすことができる。

【００９２】

$$RTrRate = TrRate / (1+n) \text{（ビット／秒）} \cdots\cdots (2)$$

【００９３】今、遅延量を考慮した場合のルート重み付け値をＲｏｏｔＷＤとし、予定転送レートをＴｒＲａｔｅＤとする。また、隣接端末（あるいは中継端末）７１Ｂの遅延量をＴｒＤとし、ビットエラーレートをＢＥＲとし、転送レートの重み付け係数をＴＷＫ、ビットエラーレートの重み付け係数をＢＷＫとする。この場合のルートの重み付け値は、次の（３）式により求められる。

【００９４】

$$RootWD = BER * BW / (TrRateD / (1+TrD)) * TWK \cdots\cdots (3)$$

【００９５】したがって、遅延量を考慮してルート重み付け値を設定することで、隣接端末（あるいは中継端末）７１Ｂのデータ転送遅延を配慮した最適ルートの検索が可能になる。

【００９６】なお、以上説明した実施例および変形例はアドホックに限るものではなく、各無線端末を中継端末としても使用する他の無線通信システムに同様に適用することができる。

【００９７】

【発明の効果】以上説明したように請求項１～請求項６記載の発明によれば、ルート検索要求を次々伝達する端末が次に送出する通信路の重み付け値を付加して送信することにしているので、通信の相手先はルート検索要求を受信した段階でこれまでの重み付け値を基にしてどのルートが最適かを簡単に判別することができる。したがって、ルートの迅速な検索が可能になるだけでなく、通信を開始する側ではルートの検索処理が簡単となる。

【００９８】また請求項２記載の発明によれば、一端を隣接する他の端末に接続された各通信路のビットエラーレートを測定するビットエラーレート測定手段と、一端を隣接する他の端末に接続された各通信路ごとにそれらの通信路を使用したデータの転送速度を設定する転送速度設定手段を設けたので、ビットエラーレートとデータの転送速度を用いて重み付け値を設定することができ、通信速度とデータの信頼性の双方から適正なルートを選択することができる。

【００９９】更に請求項３記載の発明によれば、データ中継手段がデータを送出する通信路が使用できなくなったときルート決定手段の決定したルートの残りを使用して通信を開始した端末にこれを通知する通信不可時通知手段とを無線端末に具備させたので、通信ができなくなったときに通信を開始した端末にこれを通知することができ、必要に応じてルートの再設定が可能になる。この場合にも通信を再開する側の端末の負担が少なく、かつ迅速な対応が可能である。

【０１００】また請求項４記載の発明によれば、ルート検索要求に付加される重み付け値は、ルート検索要求の送信元から経由した各通信路の重み付け値の加算値なので、ルート決定手段はこの加算値の大きさを単純に比較することで決定することができる。

【０１０１】更に請求項５記載の発明によれば、通信路を次々に選択してルートを設定していくときにすでに選択した通信路を再度選択しないようにしたので、通信の相手先に到達する手前で閉ループを形成するような経路の選択を防止するだけでなく、トラフィックの減少にも効果がある。

【０１０２】また請求項６記載の発明によれば、ルート決定手段は、重み付け値と共に、ルート検索要求が各ルートを経て受信されるまでの所要時間を用いて最適のルートを決定するので、実際の通信速度を基にした実用的なルート選択が可能になる。

【図面の簡単な説明】

【図１】本発明の一実施例で適用されるローカルネットワークのある状態を示した説明図である。

【図２】本実施例でローカルネットワークに参加する無線端末の回路構成の要部を表わしたブロック図である。

【図３】第５の無線端末の回路構成を示したブロック図である。

【図４】図３に示した情報処理ＣＰＵユニットの回路構成を示したブロック図である。

【図５】図３に示したメモリユニットの回路構成を示したブロック図である。

【図６】本実施例で無線端末の１つがローカルネットワークに参加する場合の処理の最初の段階における前半部分の流れを表わした流れ図である。

【図７】本実施例で無線端末の１つがローカルネットワークに参加する場合の処理の最初の段階における後半部分の流れを表わした流れ図である。

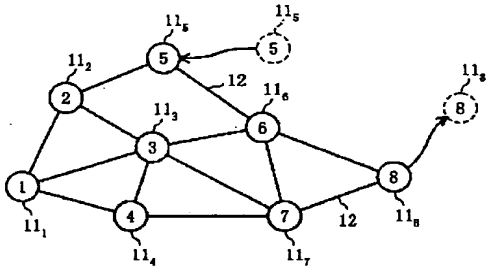
【図８】本実施例で第６の無線端末がその周囲の無線端末と接続を試みる状態を表わした説明図である。

【図９】本実施例で２つの端末間での転送レートの要求とこれに対応した応答を表わした説明図である。

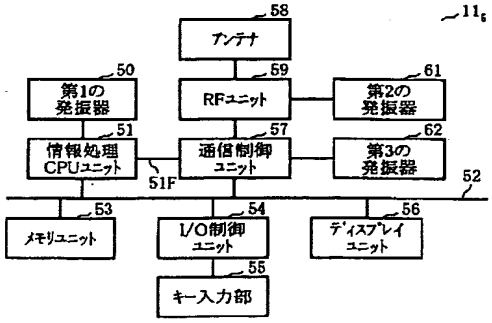
【図１０】本実施例で２つの端末間でのビットエラーレート検出コマンドの送出とこれに対する返答の様子を表

わした説明図である。
【図１１】図６に示した処理以降の処理としてローカルネットワークに参加した端末とその周囲の端末との間で行われるリンクの重み付けの処理の流れを表わした流れ図である。
【図１２】本実施例でローカルネットワークのある時点の状態をルート重み付け値と共に表わした説明図である。
【図１３】本実施例で通信を開始する端末がルートを決定するために行う処理の流れを表わした流れ図である。
【図１４】本実施例で通信を要求した端末と相手先の端末の間でルートが設定される様子を一般化して表わした説明図である。
【図１５】本実施例で各端末がこれらに送られてきたルート検索コマンドを処理する手順を表わした流れ図である。
【図１６】ステップＳ１４４で示した着端末による検索ルート返答処理の流れを表わした流れ図である。
【図１７】通信の行われているルートの途中の端末がローカルネットワークから脱退する一例を示した説明図である。
【図１８】本実施例で通信開始後の中継側の各端末の処理の流れを表わした流れ図である。
【図１９】本発明の変形例における無線端末の構成を表わしたブロック図である。
【図２０】この変形例で３つの無線端末間でルートが形成される簡易な構成の場合を示した説明図である。
【符号の説明】
１１、７１　無線端末
３１　転送速度ネゴシエーション部
３２　ビットエラーレート検出部
３３　リンク状態検出部
３４　ルーチング重み付け算出部
３５　ルート重み付け加算部
３６　ルート検索コマンド送出部
３７　検索ルート選択部
３８　検索ルート返答部
３９　ルーチングデータ転送部
５１　情報処理ＣＰＵユニット
５３　メモリユニット
５７　通信制御ユニット
７４　遅延量検出部
７５　遅延量保存部
Ａ、７１Ａ　発端末
Ｂ、７１Ｂ　隣接端末
Ｃ、７１Ｃ　着端末
Ｄ　中間端末

【図１】



【図３】



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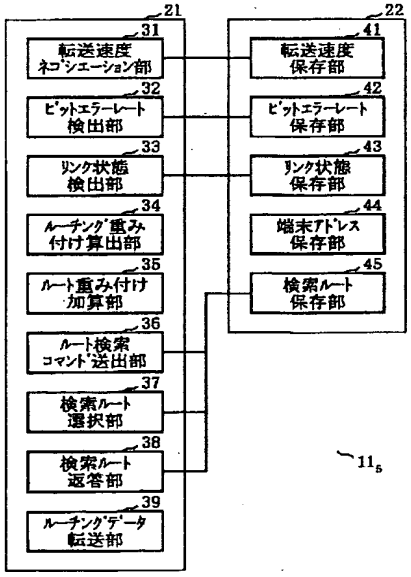

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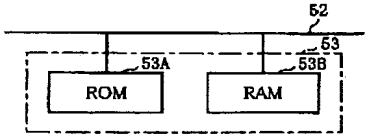

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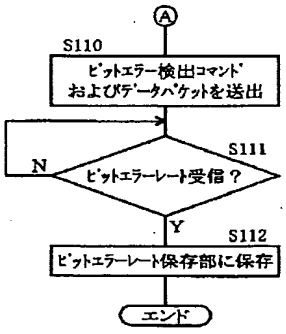

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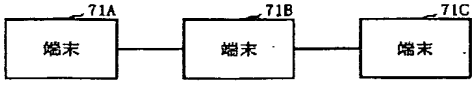

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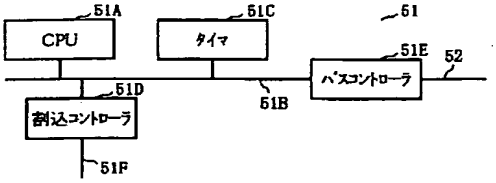

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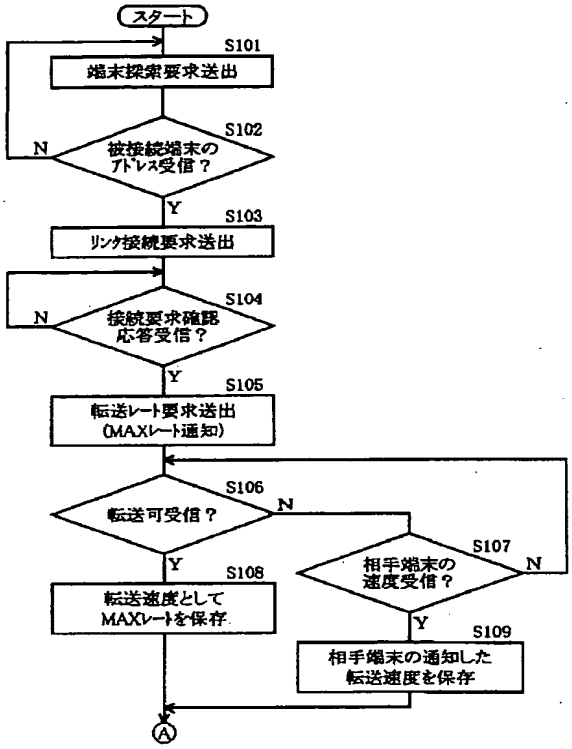

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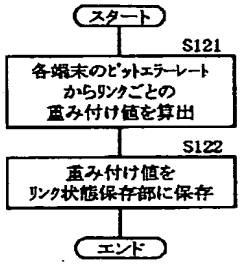

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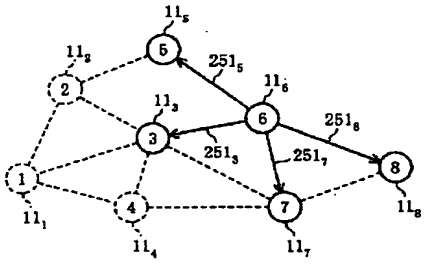

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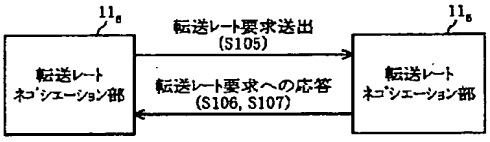

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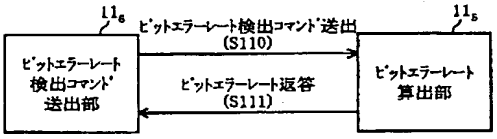

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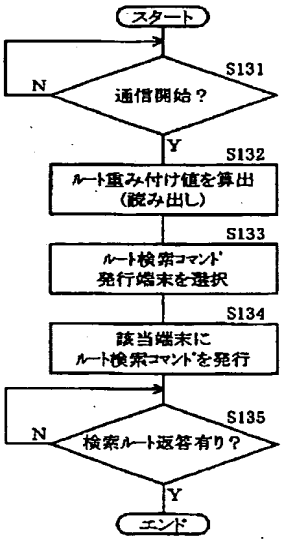

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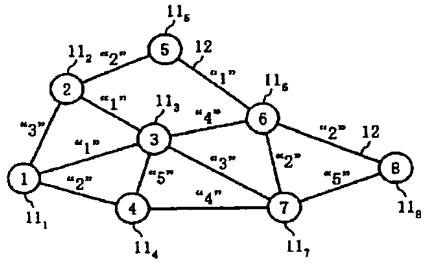

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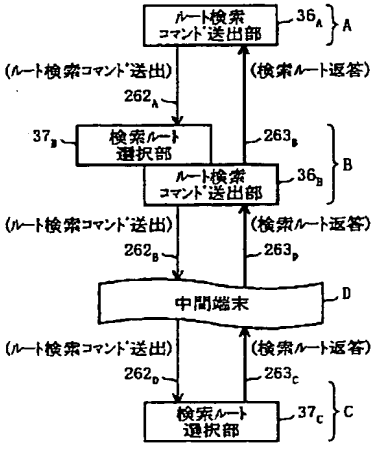

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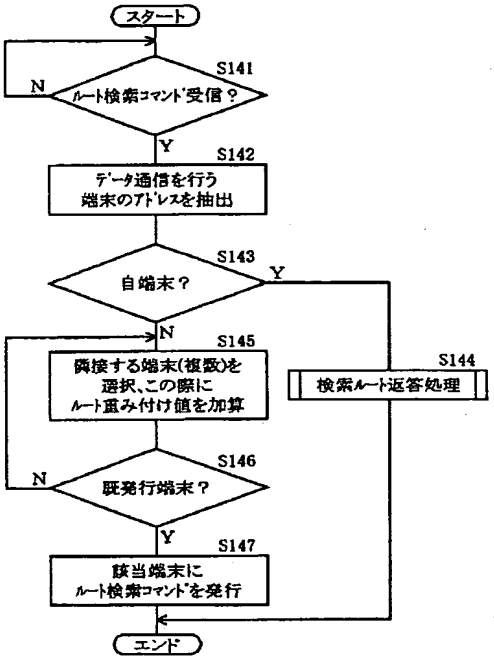

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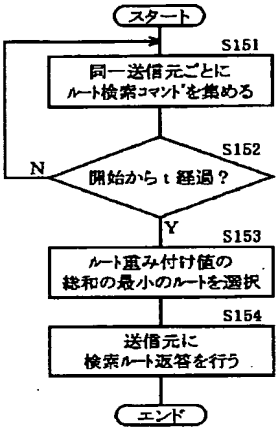

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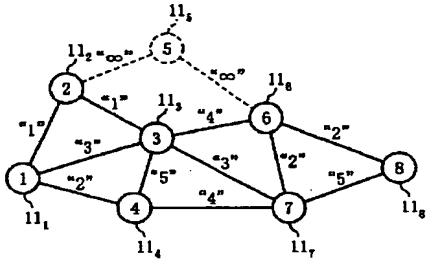

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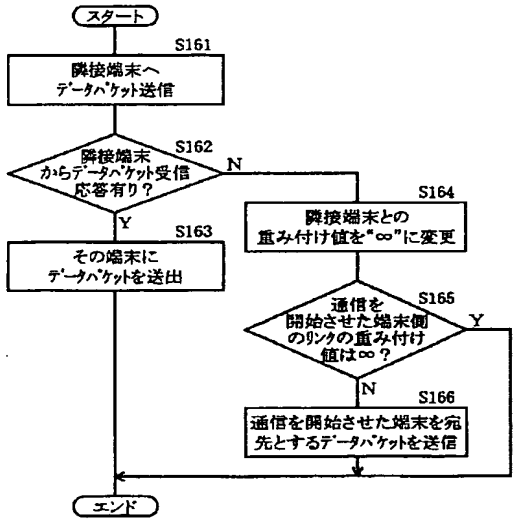

【図１９】